ENGINEERING AND MINING JOURNAL

A McGRAW-HILL PUBLICATION

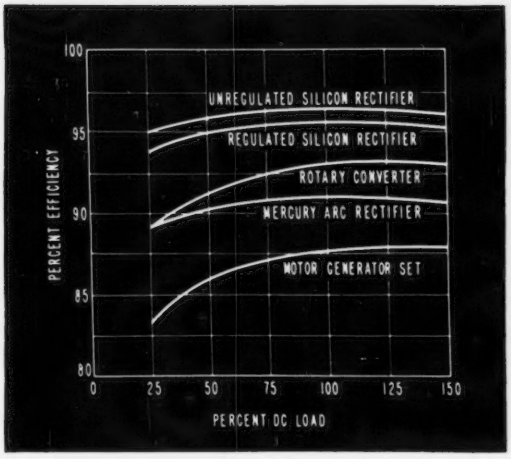
JULY 1961

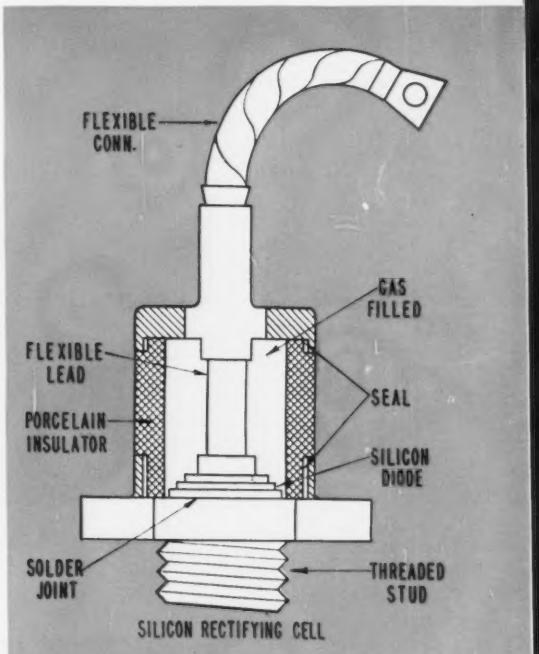
PRICE ONE DOLLAR

FOUNDED 1866

Power Conversion for the Mining Man

SPECIAL REPORT





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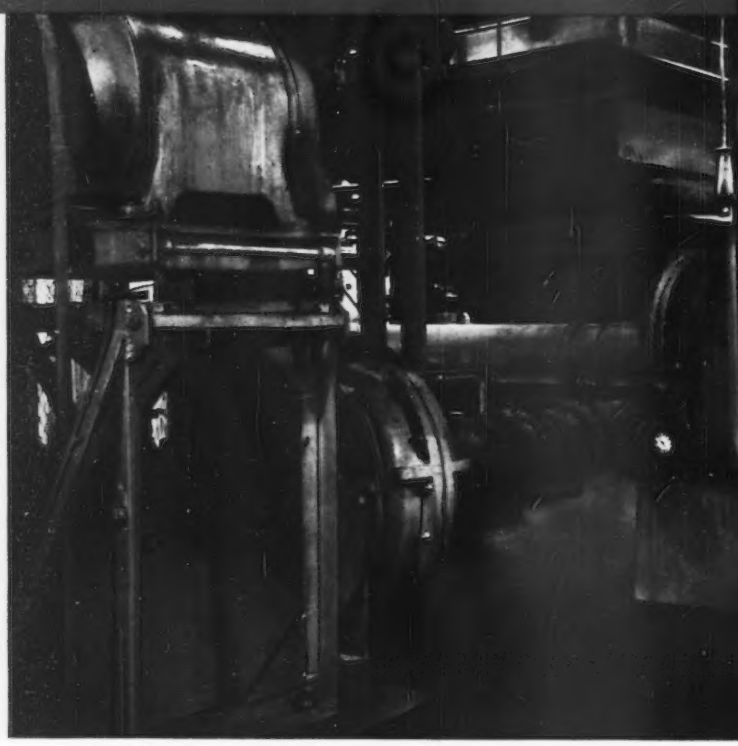
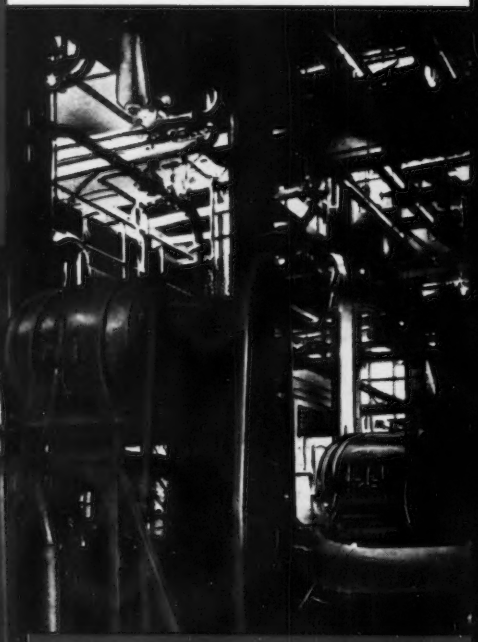
Iron-Ore Concentrating Plant of Quebec Cartier Mining Co.

Lac Jeannine, Quebec





Two of three Hydroseals in one of the four Tailings lines in the Concentrator

This first large-scale project to develop the rich specular hematite of northern Quebec Province for world markets, called for gigantic planning and insistence on efficient equipment. Ask A-S-H engineers to review your pumping problem.

THE ALLEN-SHERMAN-HOFF PUMP CO.
Dept. B—P.O. Box 635, Paoli, Pa.
Representatives throughout the World

54 Hydroseals in present operation

Tailings are handled by 4 separate lines, 3 operating and one standby. Each line consists of 3 stages at the Concentrator, and one stage at a booster station 5,000 ft. away.

– 16 pumps – D-6-5 (14" x 12")

Tailings Transfer
– 2 pumps – D-6-5 (14" x 12")

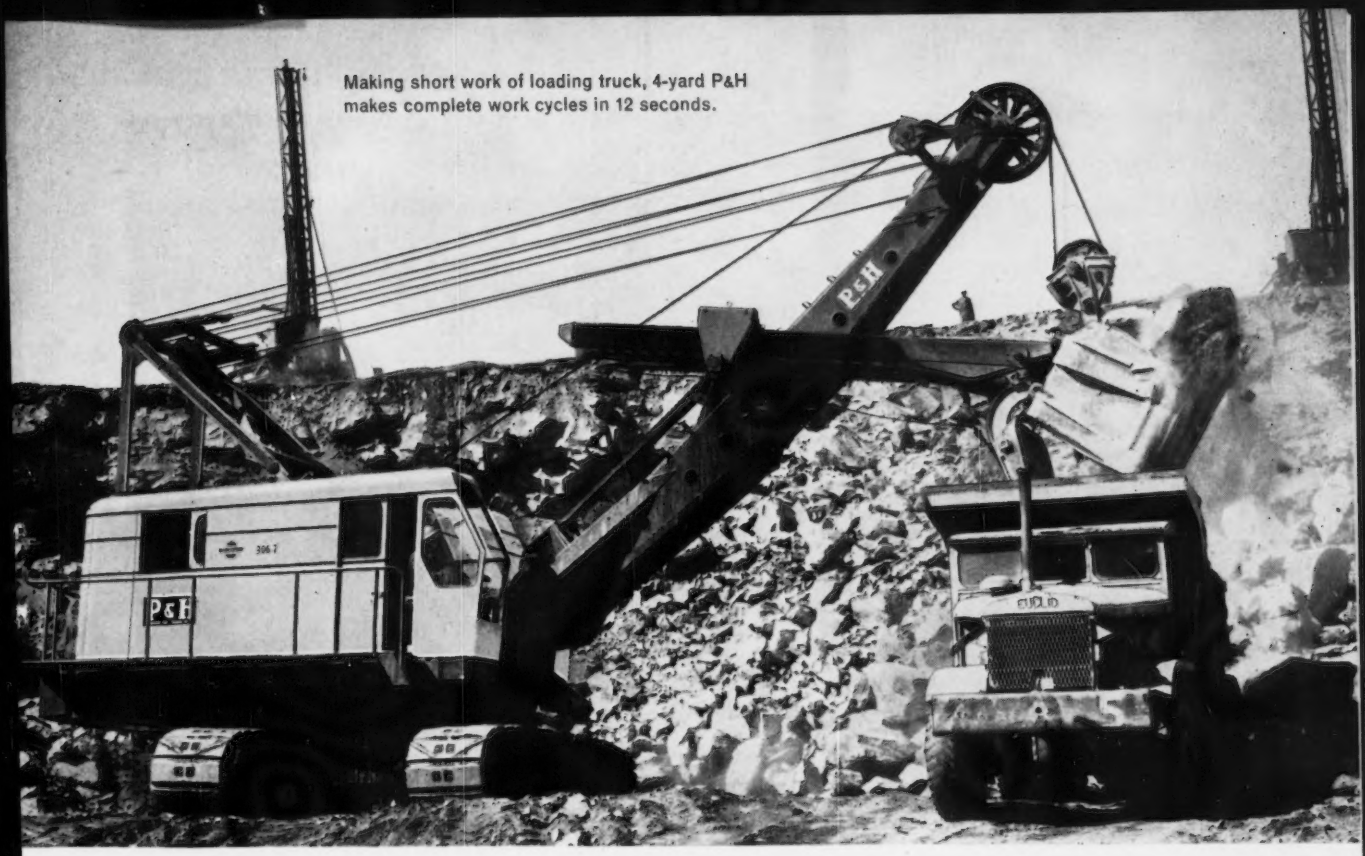
Spiral Feed
– 12 pumps – D-6-5 (14" x 12")

Thickener Underflow
– 6 pumps – B-6-5 (6" x 6")

Sump and Dust Slurry
– 8 pumps – A-6-5 (3" x 3")

Sumps
– 10 pumps – A-6-V (3" x 3")

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED



Making short work of loading truck, 4-yard P&H makes complete work cycles in 12 seconds.

Magnetorque swingers are the reason . . .

"4 yard P&H out-produces two 2½ yard shovels"

. . . STOCKBRIDGE STONE COMPANY, Atlanta, Georgia
Division of VULCAN MATERIALS COMPANY

Powerful P&H handles heavy rock with tireless ease as it works 16 hours a day digging and loading shot rock.

J. G. Lambert, Superintendent, has this to say about his operation— *"Our 4 yard P&H shovel, with Magnetorque swingers, accounts for more than half of the yardage produced at our Fortson quarry. It actually produces more than both of our other 2½ yard shovels combined."*

12 to 15 seconds work cycles. Stockbridge Stone supplies aggregate throughout Georgia, Alabama, and to four company-owned plants that manufacture concrete blocks and ready-mix. Of prime importance to them is the speed and dependability with which their shovels can excavate rock and load trucks to keep their processing plants in production. This company reports that their P&H shovel loads 18-ton trucks in 5 or 6 passes with work cycles averaging 12 to 15 seconds.

Edward Pitts, operator of the P&H says that Magnetorque swingers are the reason he gets better than 25% faster work cycles. He points out that Magnetorque swingers, unlike friction-type clutches, never over heat, and are not affected by temperature changes or load size.

P&H works two 8 hour shifts per day. To meet the heavy demand for aggregate, Stockbridge operates their 4-yard P&H shovel on a 16-hour day . . . and they operate in all types of weather, even the heaviest rains. This company has proven to itself that P&H delivers exceptional performance under the most rigorous conditions—steady, fast cycles with no downtime other than normal preventive maintenance.

Another feature, "Bud" Lambert stresses, is the propel brake on the P&H—this brake control gives more productive working time because it eliminates the constant need to "dog" or "undog" the machine with clumsy jaw clutches for every move.

For more information on this job, write for Case History 136.

HARNISCHFEGER P&H
Milwaukee 46, Wisconsin

Mining Calendar

Idaho Mining Association, annual meeting, Sun Valley, Idaho, July 5-8

Diamond Drilling Symposium, Broken Hill branch, Australasian Institute of Mining and Metallurgy, Broken Hill, N.S.W., Aug. 21-25

Conference on Metallurgy of Semiconductors, AIME, Hotel Ambassador, Los Angeles, Aug. 30-Sept. 1

11th National Chemical exposition, Chicago Section, American Chemical Society, Chicago, Sept. 5-8

American Mining Congress annual convention, Seattle, Wash., Sept. 11-14

Commemoration of the 50th Anniversary of Froth Flotation in the U.S., sponsored by MBD of SME, Cosmopolitan Hotel, Denver, Sept. 17-20 1961

National Safety Congress and Exposition, Mining Section, Pick-Congress Hotel, Chicago, Ill. Oct. 16-19

The Metallurgical Society, AIME, fall meeting, Hotel Pick-Fort Shelby, Detroit, Mich., Oct. 23-26

Northwest Mining Association Convention, Davenport Hotel, Spokane, Wash., Dec. 2-3 1961

AIME annual meeting, New York City, Feb. 18-22 1962

Pacific Southwest Minerals Industry Conference, sponsored by the San Francisco, Nevada and Southern California sections of AIME, Palace Hotel, San Francisco, April 12-14, 1962.

Coming Up

More on beryllium—News is breaking (see p 18) almost every week in the field of beryllium, both here and abroad. New processes are being put to work on the disseminated ores of Utah. Latin American orebodies are being opened. In September 1960, E&MJ published the available data on the new boom in beryllium. A follow-up article, with current reports from ore producers and metal manufacturers and with flowsheets of the new processes is now being put together.

Iron in the West—In another fast-breaking trend, iron ore shipments are increasing from the Western part of North America. E&MJ's correspondents report next month on the new mines; where they are, what they're doing, and who's buying the ore.

And on the Iron Range—Reports from the country north of Duluth: where new haulage techniques are cutting costs and speeding output, and where fragmentation seems to be improving with each blast.

95th YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

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86 Seventh Commonwealth Congress Details African Mining Practices

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Rubber mattress for bed of coal

B. F. Goodrich lining reduces chute maintenance costs by two-thirds

Two thousand tons of coal a day cascade down that 21-foot chute and into the coal breaker. At first, the chute was lined with ⅜" thick steel plates for protection. But the pounding, grinding action of the chunky coal cut through the plates in 4 to 6 weeks. The frequent replacements were costly. Welding the plates onto the chute was troublesome.

When a B.F.Goodrich distributor heard of the problem, he recommended that the chutes be lined with Armorite, a rubber especially compounded by B.F.Goodrich to stand terrific abrasion. Armorite is tough, yet soft so the jagged chunks of coal bounce off it, even though they hit with great force.

Installing it was simply a matter of bolting it to the chute. Result? Instead of lasting just a few weeks, Armorite took the wear and tear for more than 5 months, carried 260,000 tons of coal, reduced chute maintenance costs by at least two-thirds.

B.F.Goodrich Armorite can be used in dozens of ways—as a liner, curtain or throw mat for protection against abrasives. Can be ordered with or without a reinforcing back of fabric, fiber or steel.

Your B.F.Goodrich distributor has full information. And, as a factory-trained specialist in rubber products, he can answer your questions about any of the products BFG makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-149, Akron 18, Ohio.*

B.F.Goodrich

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Articles in this issue of

ENGINEERING AND MINING JOURNAL

Continued from p 2

6 Post Graduate Work at Bingham Canyon—1911

As guest author of this month's "Behind the By-Lines," Mr. Lou Buchman, retired operating vice president and member of the board of Kennecott Copper Corp., does some reminiscing about his first graduate work in the School of Hard Knocks.

The knock was a tangible one, and the certificate which accompanied it serves as title for the piece: "The Man Who Blackened My Eye."

Mr. Buchman has been called "the biggest dirt-mover of them all," and he is credited for the basic engineering which created the great Bingham Copper pit. He joined the mining organization of the late D. C. Jackling, who first conceived the idea of profitably mining the low-grade copper ore deposits near Salt Lake. Mr. Buchman holds the Saunders medal, and an honorary doctorate from Michigan's College of Mines and Technology.

73 Power Conversion and the New Look in Mines and Plants

In the third of our series of Special Reports, E&MJ discusses the new types of power conversion units available to the mining industry, with some expert advice on choice, selection and application. In the latter area, the authors have broken down their story into underground and open pit applications, and also discuss beneficiation and refining.

The new instruments, using the semiconductor materials, provide new ranges in portability, maintenance, air requirements, etc. The authors supply comparative charts on the various types of conversion equipment to bring you up to date on today's equipment and on the changes in technology since you finished school.

82 Phelps Dodge Switches from Poling to Gaseous Reduction

This spring, E&MJ visited the P-D Ajo smelter in Arizona to look at the successful installation of a gas reforming unit which has eliminated green poles in the smelter. You'll find a flowsheet, complete description, and even a chart of the actual readings of meters and gages on the main reforming plant control panel.

Among the advantages cited with the new method: improved safety and housekeeping; elimination of pole storage in the converter aisles; pushbutton control; and an accident-free operation with gaseous refining.

86 The Commonwealth Congress Visits South Africa and Rhodesia

A month-long meeting of mining and processing men, packed with information, modern ideas and technology with a touch of conviviality, wound up in late May in South Africa. The Seventh Commonwealth Mining and Metallurgical Congress, which took place in the Union and in the Rhodesias, probably set a record in information given, properties visited, and details set down.

The history of the area, and the great mass of other data presented at the Congress defies summary—but we've taken a try at it. Some of the strongest impressions: Africa's mines are well engineered to combat the problems of depth, heat and water; scientific management (we call it industrial engineering) began in African mines in the 30's and has helped improve labor efficiency and keep costs in some areas to about the same level they held twenty or thirty years ago.

Space has held us to a summary of four papers. The first discusses a nitrous fume extraction plant for use behind blasting in underground stopes. It permits earlier entry to an area after a blast and allows multi-blast shifts. The second sums up new tunnelling techniques with small equipment, low costs and high speed. The last two cover pumping of slimes and research in metallurgy.

the cry goes out,

"Reach me the Milker"

AND FLYGT PUMPS GO TO WORK AT OGLEBAY-NORTON COMPANY COAL MINE

Racked up along Brule No. 3's main haul, five Flygt Model B-38L electric submersible pumps await the familiar call for the "Milker," a nickname given them by the mine crews. At the first sign of water accumulation along one of the solid coal walls, a Flygt is moved into place and left on its own to completely dewater the area — right down to dampness. Oglebay-Norton officials say, "We like these pumps. They are the best we have ever used. We turn them on and they do the job." Dependability, high capacity and a mere 77 lbs. to carry provide the answer to Flygt's success at this Otsego, W. Va. mine. I. R. Lambert, mine foreman said, "We had to have something that would work without a lot of fixing. Our Flygts fill the bill." No matter what your dewatering problem might be, Flygt has a pump in their 7 model line to lick it.

PUMP BETTER ELECTRICALLY — USE FLYGT!

FLYGT Corporation

ORIGINAL MANUFACTURERS OF ELECTRIC SUBMERSIBLE 'DIRTY WATER' PUMPS!

HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif. -IN CANADA- FLYGT CANADA LIMITED, Montreal, P. Q.

95 YEARS OF MINING

The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became *E&MJ*.

UTAH, JANUARY 1887 — The VIDETTE, Dec. 15th, says that in spite of all attempts of Mormons to convince the outside world that the Utah mines are a myth, it is gratifying to know that energetic men are hard at work at the silver mines of the Territory with fine prospects of success. Furnaces have been, and are being erected in Rush Valley, Bingham Canyon, on Cottonwood and in Pahranagat.

MONTANA, MAY 1866—A correspondent of the Sacramento UNION writes: From Salt Lake to Virginia, Montana, it is about five hundred miles; fare, $125 greenbacks or $100 in coin or dust. It stormed most of the way, and it was about all we wanted to attend to keep ourselves wrapped up, head and all, to keep from freezing; rode in sleighs all the way, with the exception of from Pont Neuf Canyon to the crossing of the Snake river, and from the "Junction" to the "Horse Prairie." It was at the mouth of Pont Neuf Canyon the downward stage was robbed, a year since, of $65,000, three or four of the passengers being murdered.

All Sorts

At a trial recently, a Cornish jury returned the following verdict: "Guilty, with some little doubt as to whether he is the man."

It is asserted by competent geologists that the supply of coal in England is in process of rapid exhaustion. The coal-fields are in extent but 5,400 square miles, and it is estimated that these fields will be entirely exhausted in less than a thousand years.

The Chicago and Great Eastern Railway Company has recently adapted the use of passenger cars wholly constructed of iron.

A lady who had read of the extensive manufacture of odometers, to tell how far a carriage has run, said she wished some Connecticut genius would invent an instrument to tell how far husbands had been in the evening when they just step down to the post-office.

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

The Man Who Blackened My Eye — Lou Buchman

The man who influenced me most—a chap named Guyman—I haven't seen for nearly half a century. In fact, I haven't seen him since that day I fired him from the job in my first "flush" of being boss of a gold mine at Bingham Canyon, Utah.

I'll never know whether Guyman deserved it or not, but when he lost his job, he hit me with a haymaker for which I will always be grateful.

That wallop which exerted such an influence on me came in the fall of 1911 when, a few years after my graduation from the Michigan College of Mining and Technology, the Utah Leasing Company hired me as superintendent to operate a small gold mining property in Bingham Canyon.

To me, the job was tremendously important—and so was I. Being called "Boss" and "The Kid Superintendent" merely expanded my ego. I was a 24-year-old who knew all the answers.

Bingham Canyon was a brawling, frontier town in those days. The one and only street, four miles long, was lined with false-fronted dance halls, saloons and gambling casinos. One Saturday night, after more than a few drinks and poor gambling luck, I rode home in a sour mood and, dismounting at the mine property, decided to inspect the mill. With only three men on the graveyard shift, I could do it easily. So I climbed the stairway to the operating area: everything was running normally and under control. On the third, or top floor, where we finished the day's ore crushing that afternoon, I found what I had unwittingly been looking for—a scapegoat. Guyman was slumped on the floor with his back against the warm side of the air receiver, snoring vociferously. He offered the perfect outlet for my bad temper, compounded by my cold, four-mile ride home.

Prodding Guyman awake, I made full use of a "Boss'" privilege, "telling him off" in no uncertain language. At the end of my harangue, I ordered him to report to me when he came off shift. Even then my mind was completely made up—I would fire him pronto, without any hearing or explanation, although I knew his work record had been completely satisfactory to that moment. When Guyman appeared in my office that morning, I called him in front of my desk and handed him his "time," saying he was through. Not saying a word, he took his check in his left hand, and without a quiver of expression, belted me in the eye with his right. It was a beautiful punch.

When my mind cleared and I picked myself off the floor, Guyman had gone. As a much deflated, black-eyed man of twenty-four, I had taken a long, long fall from my self-exalted status of "Kid Superintendent." This, then, is an apology delayed since 1911—an apology and something else. To this man goes my sincere thanks for a badly needed object lesson.

I learned one should not fire out-of-hand a man with a family to support, a man who had made a single, apparent error in an otherwise satisfactory work record. This was a vivid illustration to me, long before reading Freud, that the real reason—the inner reason—for desire to punish might well stem from our own shortcomings.

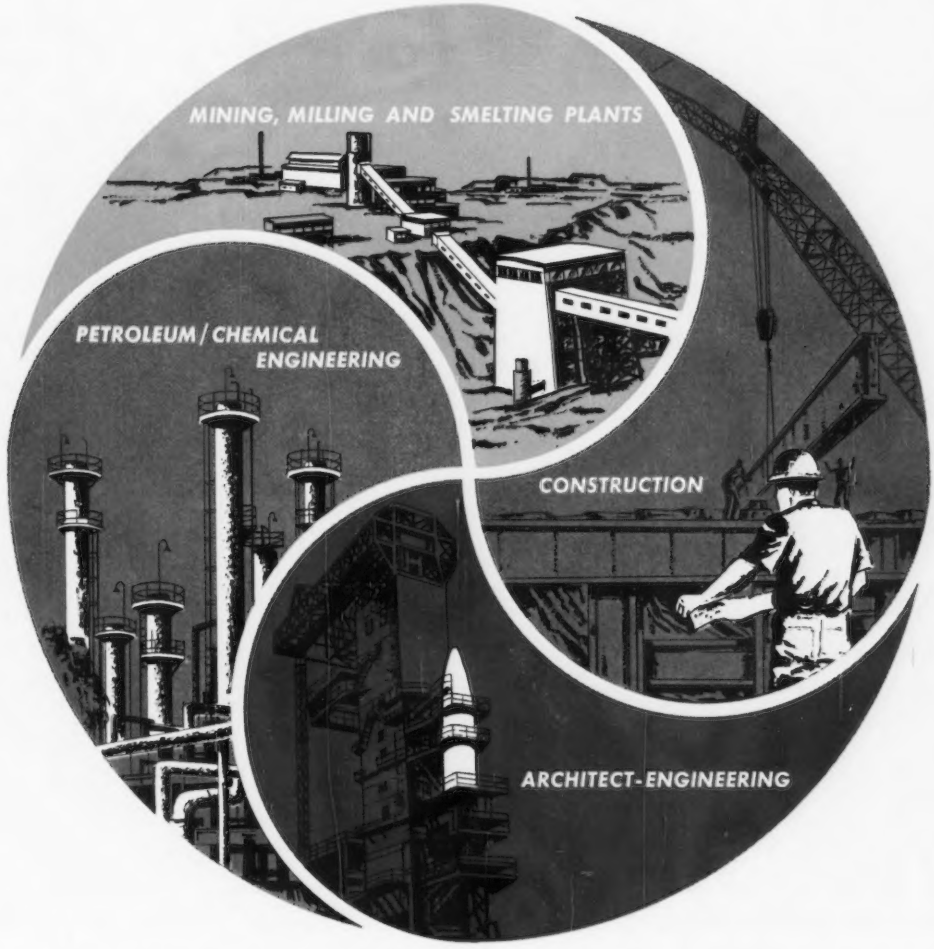
Perhaps I didn't immediately and finally resolve to live and let live, for I doubt if anyone rationalized a philosophy of life that quickly. But before boiling over at a labor-management bargaining table, I was likely to experience again the gnawing memory of my initial failure in industrial relations—and to feel a twinge near my once-blackened eye.

(Editor's note: Mr. Buchman, a well-known and greatly respected member of the mining fraternity, has kindly permitted E&MJ to print his story-with-a-moral; an episode which occurred long before he became general manager of the Bingham Pit and Kennecott's Western operations.)

YOU KNOW PARSONS—YOU KNOW JURDEN

NOW, MEET PARSONS-JURDEN CORPORATION

(*a subsidiary of* THE RALPH M. PARSONS COMPANY)



Recently, The Ralph M. Parsons Company acquired Anaconda-Jurden Associates, Inc. from The Anaconda Company. By combining the engineering knowledge, construction skills, and world-wide experience of the two companies, Parsons-Jurden is able to offer international services of unparalled versatility.

Parsons has a well established reputation in the petroleum, chemical, nuclear, missile, electronic, water development, and other fields. Jurden needs no introduction to mining, milling and smelting, power, and related industries.

Bring your engineering-construction problems to Parsons-Jurden to get the benefits of total capability from single source responsibility.

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SWITCH TO KON-TORK DIFFERENTIAL..

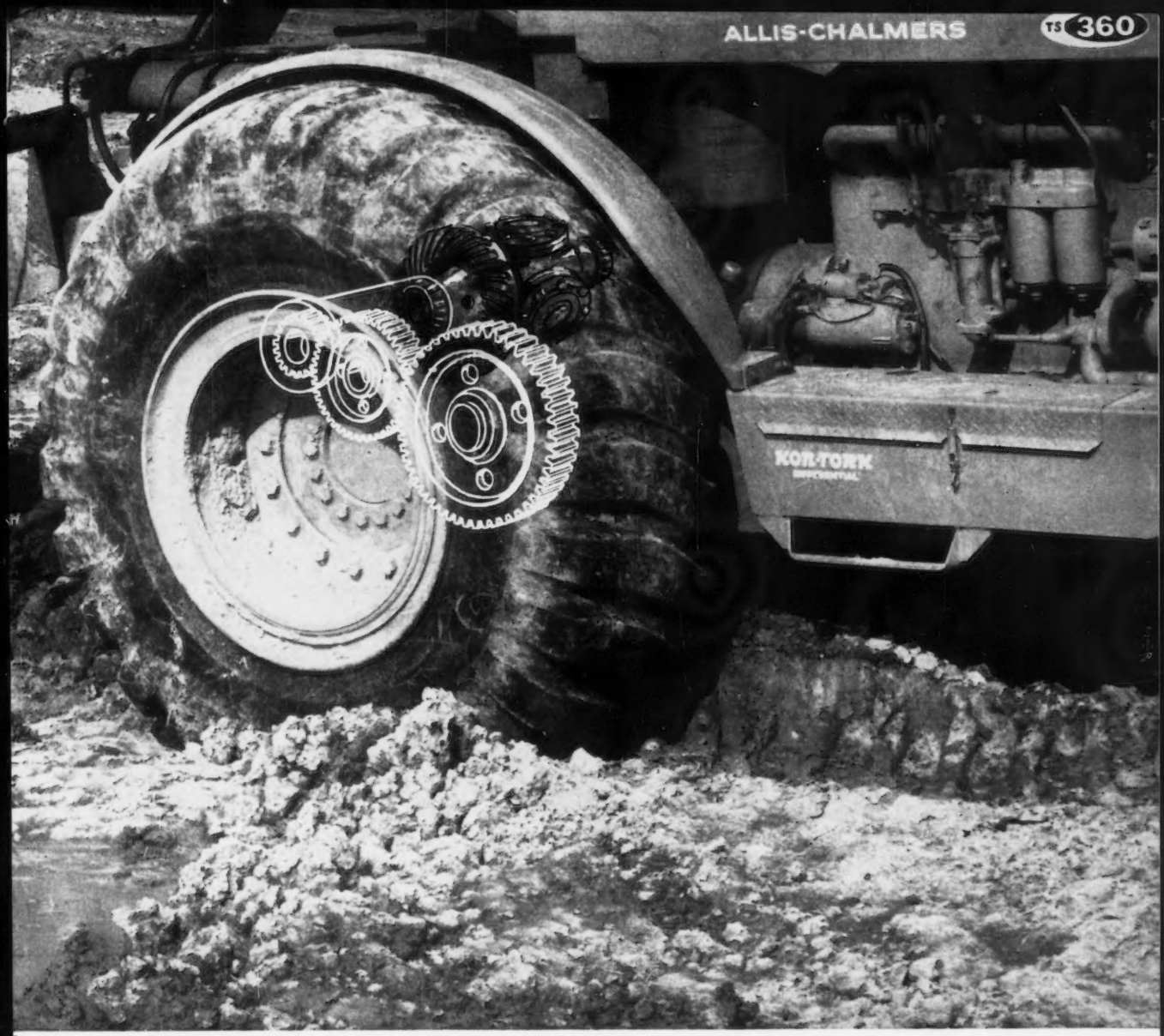
KON-TORK differential provides every Allis-Chalmers motor scraper with maximum traction to match any working condition—provides you with all-weather production.

Only Allis-Chalmers offers exclusive KON-TORK differential in every motor scraper. This traction-boosting benefit makes dirt pay under severe job conditions.

KON-TORK works automatically, whenever it's needed. In the cut, on the haul or soft fill, it helps you by automatically controlling the transfer of torque to each drive wheel . . . giving you the benefit of all available traction *all the time.*

Example: When one drive wheel hits soft going, KON-TORK takes hold and transfers torque from the slipping wheel to the wheel with solid footing to keep the machine moving out. Another nice thing

move ahead with



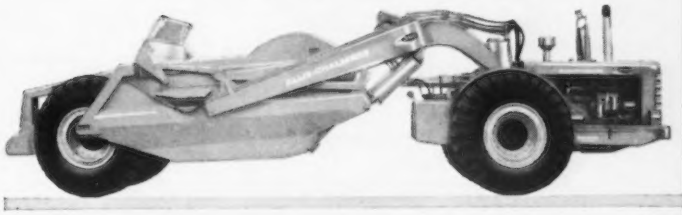
.TRACTION MAGIC, EVEN IN MUD

about KON-TORK . . . it's simple! Only five working parts . . . never needs adjustment!

But this is only one of many features that keep Allis-Chalmers motor scrapers out front on every job. You should see what *full-power steering—double-acting bowl jacks—hydraulic forced ejection and highest apron lift* can do for your production. Try any one of 3 models from 10 to 30 yards. See for yourself. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

KON-TORK is an Allis-Chalmers trademark.

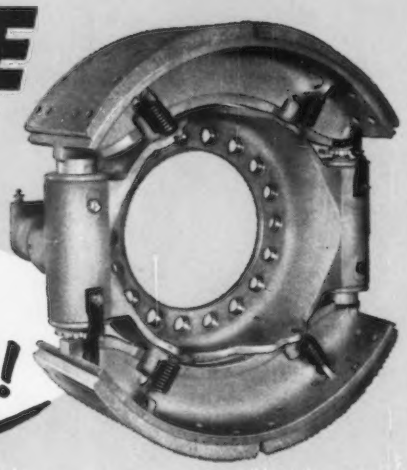
Now available in Persian Orange or Allis-Chalmers Yellow at no extra cost.



ALLIS-CHALMERS

. . . power for a growing world

It's here! New HEAVY-DUTY STOPMASTER BRAKE



Biggest News in Brakes for Off-Highway Equipment in over 30 years!

To meet the growing need for more versatile, more compact, more dependable braking equipment in off-highway operations, Rockwell-Standard® now presents a completely new concept in brake design.

This new brake is specifically engineered for use on scrapers, prime movers, earth and rock wagons, dump trucks and similar construction vehicles. Available in 17, 20¼, 22 and 26-inch diameters and in 4 to 10-inch widths.

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- **Less Heat Fade**
- **Greater interchangeability of parts**
- **Heavy Duty ¾ inch tapered Econoliners®**
- **Adjustment frequency reduced**
- **Rugged Design**
- **Extended Drum Life**

Only the Heavy-Duty Stopmaster offers:

"BALANCED DESIGN" AND NEW ACTUATION PRINCIPLE

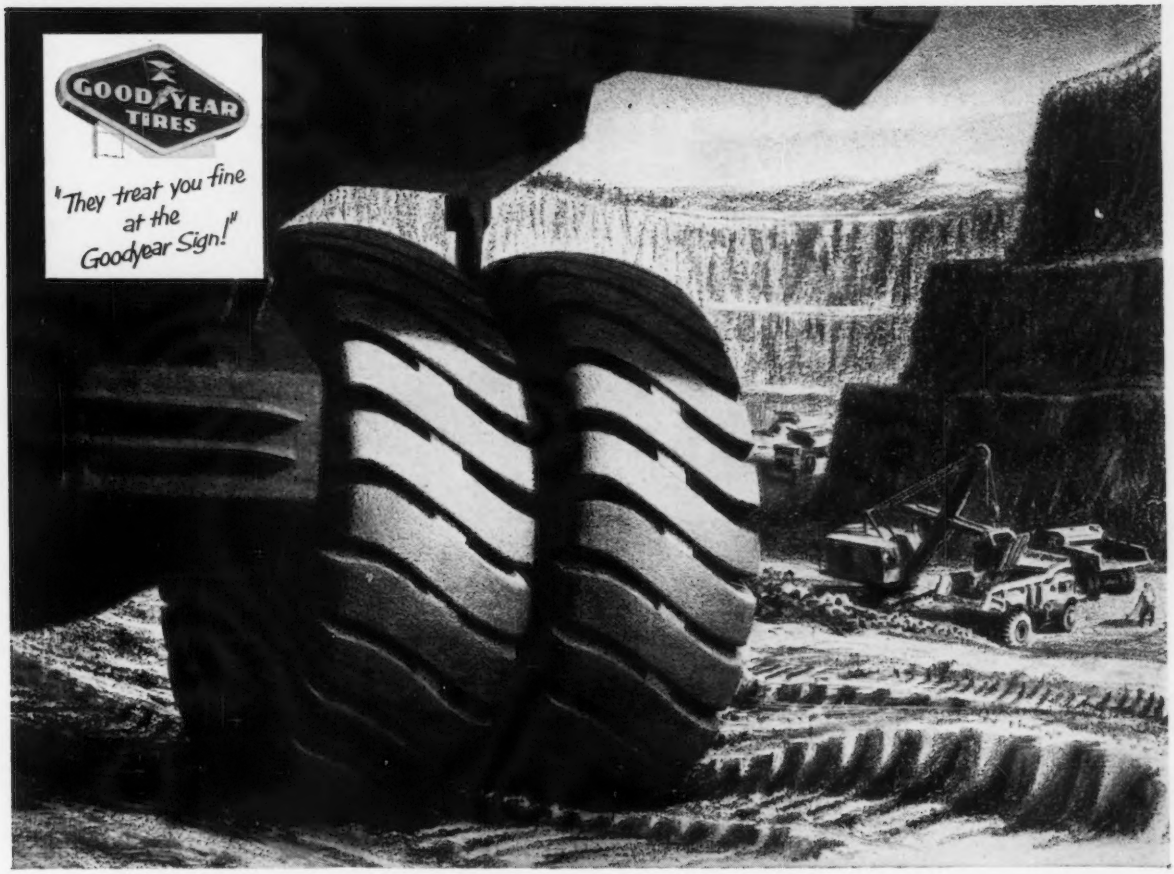
Results in improved braking performance and lower operating temperatures. In Dual-Actuation design, both shoes do an equal amount of work. Balanced shoe-action assures more dependable service; faster, surer stops.

HYDRAULICALLY OPERATED

New hydraulic cylinders offer more compact design and increased mounting flexibility for better protection. External cylinders, located outside of drum, eliminate heat damage and overheating of fluid. For air-over-hydraulic systems, air volume requirements are considerably less. Actuation time is reduced, with faster response of hydraulic system. The Stopmaster Brake is well suited for straight hydraulic, air-over-hydraulic, or vacuum-over-hydraulic operation.

Another Product of... **ROCKWELL-STANDARD CORPORATION**

Brake Division, Ashtabula, Ohio



You never had 'em so tough!

HARD ROCK LUG XTRA TRED

Here it is! From Goodyear's advanced technology and processes—

HARD ROCK LUG XTRA TRED—the mine and quarry tire that's built with extra tread to take it where the going's tough!

It's made with 3-T Nylon Cord—triple-tempered by Tension, Temperature and Time—that makes *the world's toughest tire bodies.*

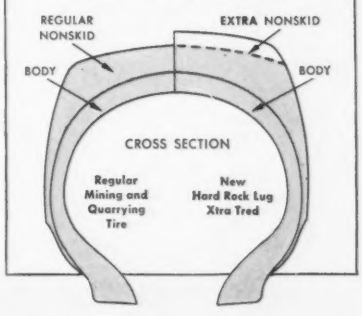
It has specially compounded rubber that embodies remarkable super-toughening agents for far greater chip-, wear- and penetration-resistance—that produces *the world's toughest treads.*

And, with its thicker nonskid tread depth (as much as 71% thicker) for harder-biting, longer-wearing lugs, you take out *more pay loads in less time and at lower cost*—with fewer maintenance headaches, too!

Ask your Goodyear dealer about Hard Rock Lug Xtra Treds, *now.*

Goodyear, Truck Tire Department, Akron 16, Ohio.

MORE AND TOUGHER RUBBER IN THE RIGHT PLACES!



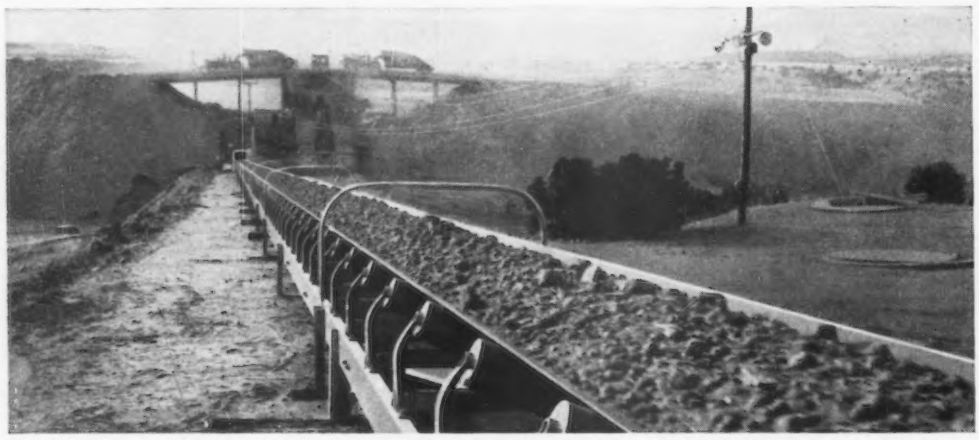
Buy and Specify Truck Tires by

GOODYEAR

Xtra Tred—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

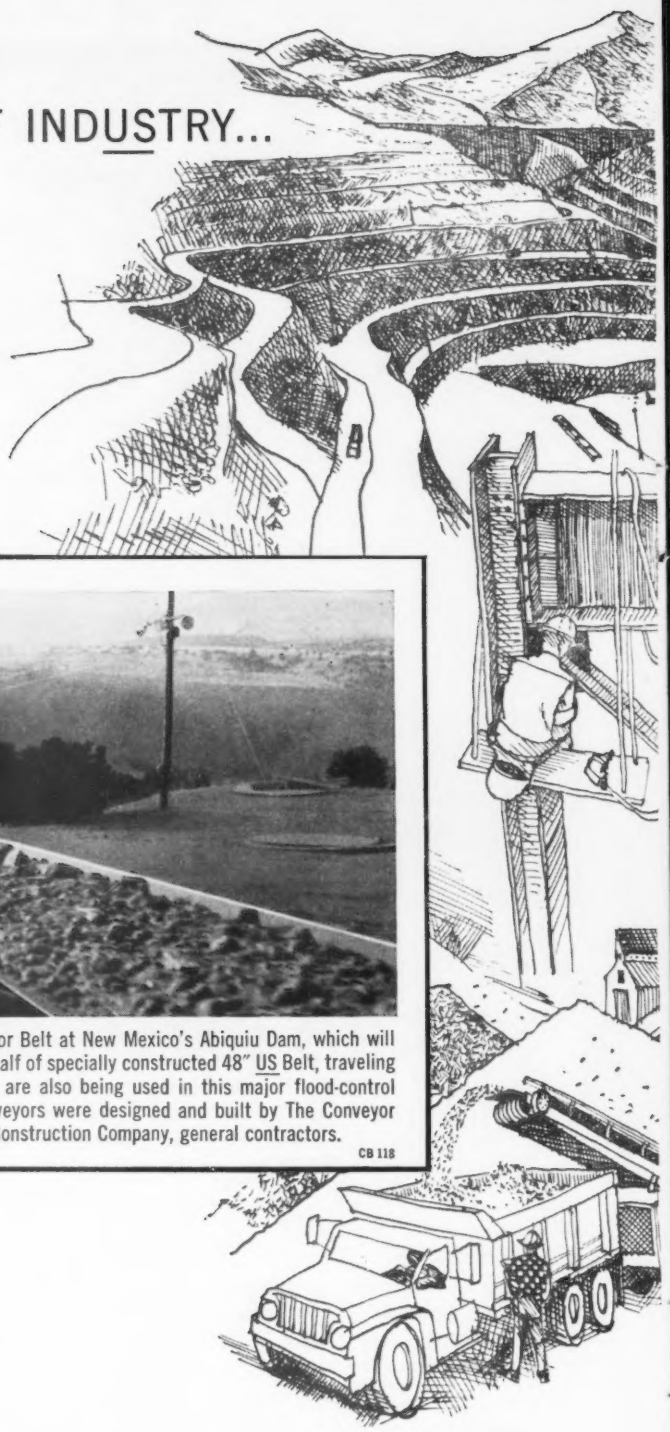
MORE TONS ARE HAULED ON GOODYEAR TRUCK TIRES THAN ON ANY OTHER KIND

AT THE HEART OF INDUSTRY...



60,000 tons of material a day are being carried by a US Conveyor Belt at New Mexico's Abiquiu Dam, which will be the fourth highest earth-fill dam ever built. More than a mile and a half of specially constructed 48" US Belt, traveling at 800 fpm, is used on this single conveyor. Other, wider US Belts are also being used in this major flood-control project to carry the more than 15,000,000 tons of fill required. Conveyors were designed and built by The Conveyor Company of Los Angeles in conjunction with US engineers for Mittry Construction Company, general contractors.

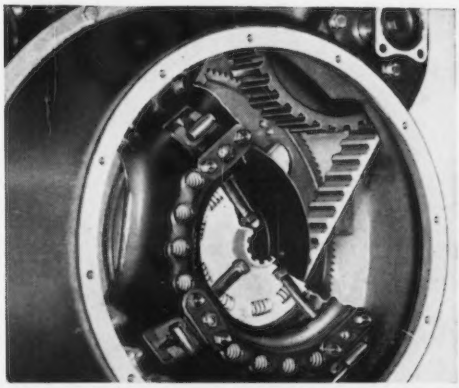
CB 118



Wherever the mining or construction industry operates, you'll find U.S. Rubber products adding their "muscle" to the job...making it easier, more efficient, more profitable. As the world's largest producer of Industrial Rubber Products, US knows the needs of mining and construction men everywhere.

6 U.S. Pilot® Pipes pump 5,000 gallons of water per minute at a Minnesota taconite mine. The pipes lead from a barge pump to two concentrators. Rubber pipes were essential, for during pumping the barge may rise or drop 10 feet, straining hose and connections. Despite its flexibility, this pipe is extremely strong... takes 250 lbs. pressure.

H 110



The revolutionary new flywheel power take-off on Reo's transit-mix truck relies on a U.S. PowerGrip "Timing" Belt for the positive, smooth, direct, and even-flowing power essential to its success. The "Timing" Belt does away with a separate engine or front-end take-off, eliminates the need for lubricants, allows a payload increase of more than 600 lbs. per trip.

TB 106

Now US brings another major development to conveyor belting—the WeatherGard cover. In recent tests this cover was unharmed by 7 times the ozone torture that causes ordinary belt covers to crack and fail. What's more, the WeatherGard cover has much greater resistance to cracking from accelerated aging, has outstanding resistance to abrasion, wear, and weather.

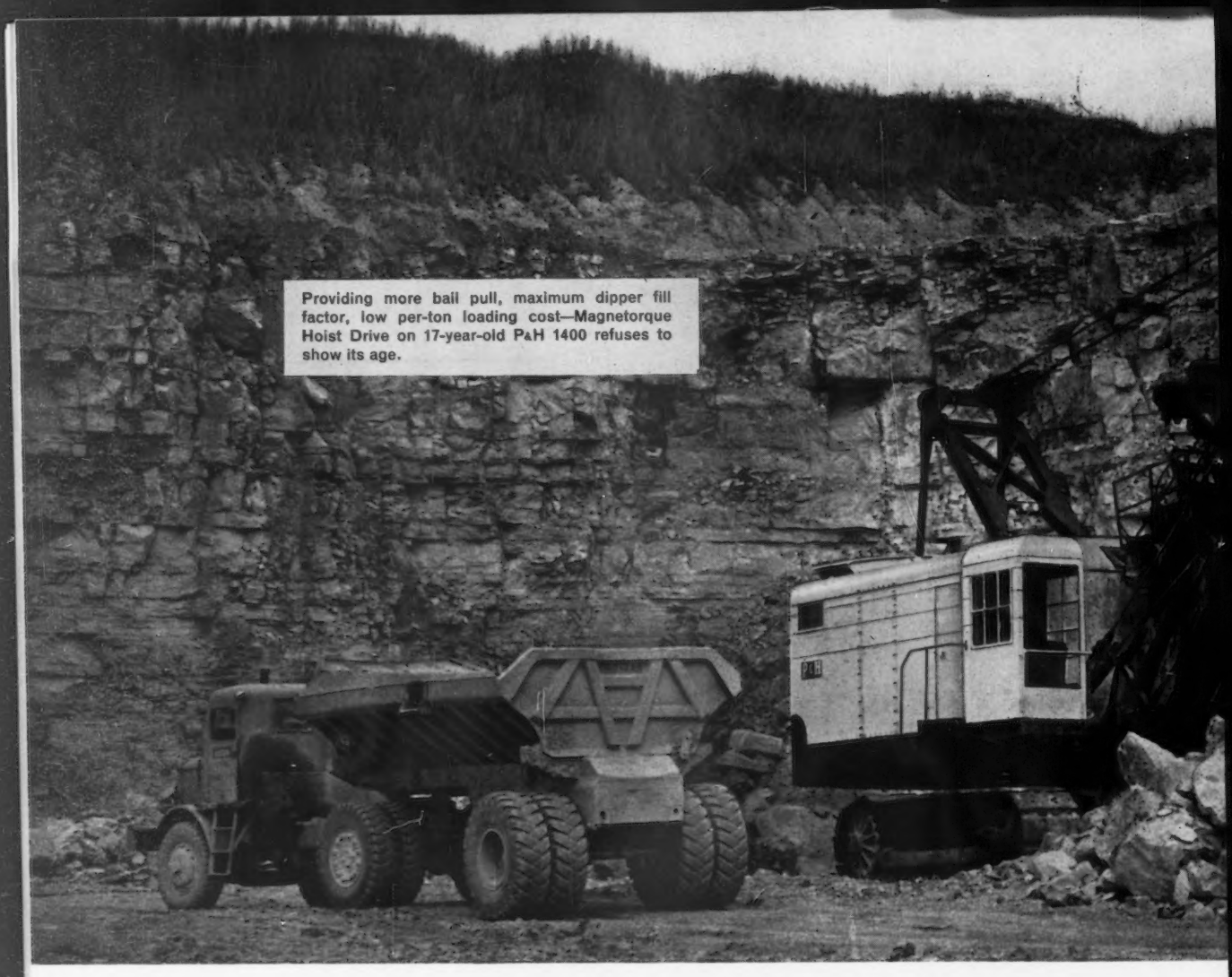
CB 119

For every industrial rubber product need, turn to US. For Conveyor Belts, V-Belts, the original PowerGrip "Timing"® Belt, Flexible Couplings, Mountings, Fenders, Hose and Packings... custom-designed rubber products of every description. Discover why U.S. Rubber has become the largest developer and producer of industrial rubber products in the world. See your U.S. Rubber Distributor or contact US directly at Rockefeller Center, New York 20, N. Y.

WORLD'S LARGEST MANUFACTURER
OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber

MECHANICAL GOODS DIVISION



Providing more bail pull, maximum dipper fill factor, low per-ton loading cost—Magnetorque Hoist Drive on 17-year-old P&H 1400 refuses to show its age.

After 17 years, first Magnetorque equipped

... at MISSOURI PORTLAND CEMENT CO.

Virgil Wendt, Quarry Supt., reports—

"Back in 1944, we bought the first P&H ever sold with Magnetorque; today this 1400 still gives us good, reliable service. If our plant needs extra limestone, we think nothing of working this shovel for 16 hours at a stretch. We still rely on it to do the job for us. Teamed with the P&H 1500 we bought in 1958, it gives us as efficient a digging operation as you'll find anywhere."

Two P&H Electrics Load 1,123,000 Tons Annually

To meet quarry production schedules, Missouri Portland's modern, five-million barrel cement plant demands absolutely dependable equipment. Two types of rock must be dug daily to supply the right "mix." To accomplish this, the two P&H Electric Shovels work at different levels along an 1835 foot long quarry face.

Equipped with a 4-yard dipper, the P&H 1400 has seen years of hard, workhorse service. One year it loaded over 750,000 tons. Now it digs at the base of the quarry's upper face, loading up to 360 tons of limestone an hour. The newer, 5-yard P&H 1500 digs at the base of the lower face, loading up to 400 tons of limestone an hour without hesitation.

Magnetorque Helps Maintain High Production

Exclusive Magnetorque Hoist Drive on these P&H machines is the key to their greater productivity. It gives more digging bail pull—puts more material in the dipper faster, with every pass. Mr. Henry Merz,

20-ton capacity trucks are loaded at the rate of about 15 loads per hour. P&H 1400 with 4-yard dipper shows it's still a workhorse.

Quick, accurate dipper spotting results from responsive electronic controls on 5-yard P&H 1500. Loads 18 to 20, 20-ton trucks per hour.

P&H electric is still going strong

Fort Bellefontaine Quarry in St. Louis County

Quarry Foreman, says—"The electronic controls on our P&H shovels are very responsive and the Magnetorque hoist drive is especially powerful."

Superior P&H Parts And Service Is Worth A Lot

Mr. Virgil Wendt has this comment to make—"I think one big reason the 1400 is still going strong is that P&H really stands behind its equipment with immediate help, should it be necessary. This is worth a lot. Harnischfeger not only builds a good shovel, but helps keep it working right."

Summary Report On 17 Year Old P&H 1400

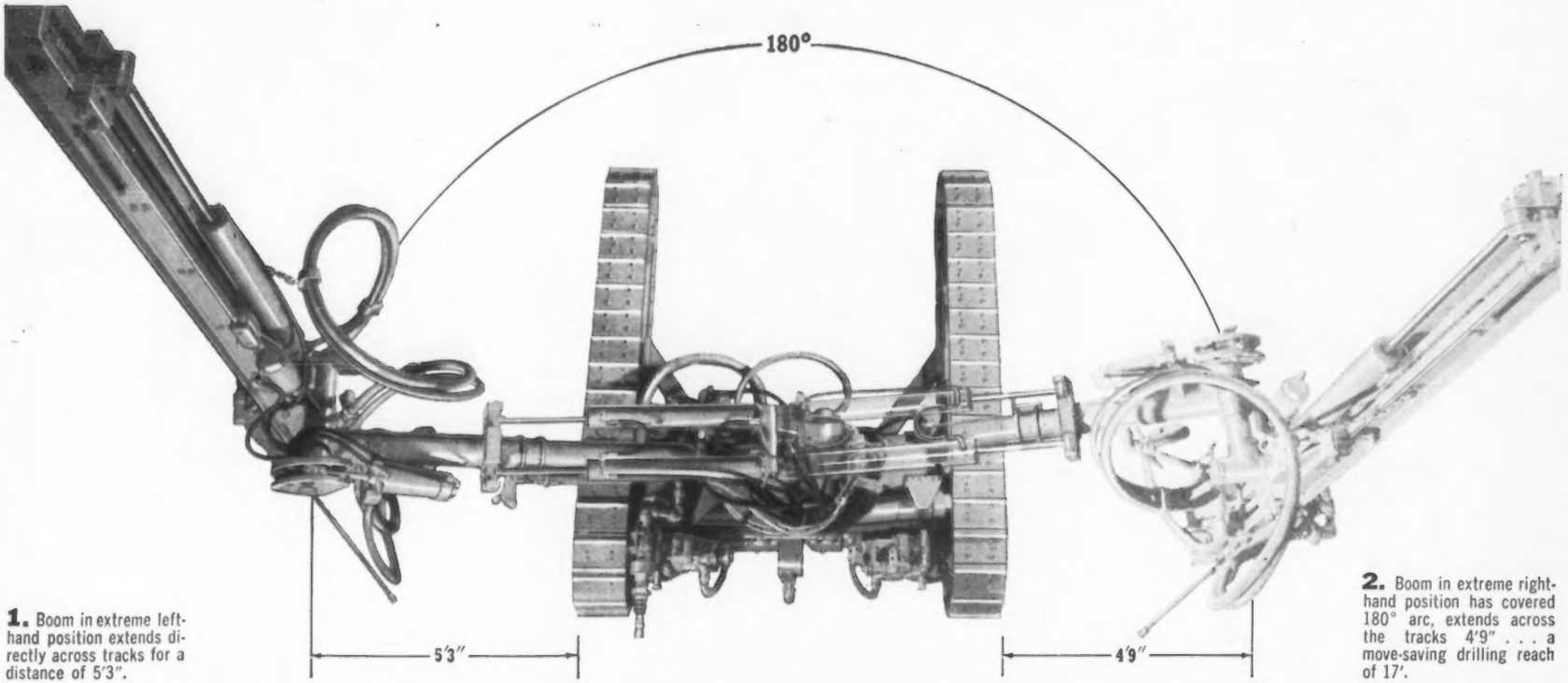
Here is how Mr. H. Clay Iten, Plant Manager, puts it—"We have no plans to replace our P&H 1400 after all these years. It's always done a good job for us; it's doing a good job for us now, and we expect it will continue to do so."

Compare all performance factors before you buy—for more detailed information on this operation, write for Case History Report No. 141 to the World's Largest Builder of Full-Electric Shovels.

HARNISCHFEGER **P&H**

Milwaukee 46, Wisconsin

61-599



1. Boom in extreme left-hand position extends directly across tracks for a distance of 5'3".

2. Boom in extreme right-hand position has covered 180° arc, extends across the tracks 4'9" . . . a move-saving drilling reach of 17'.

TRACDRIL'S 180° "BOARDING HOUSE REACH" PAYS-OFF!

More and more mining men are discovering that with the full 180° ground coverage of the G-900 Tracdril fewer moves are needed . . . that more blast holes can be drilled from every set-up.

In addition to the time-saving advantages of their 180° "Boarding House Reach", new G-900 Tracdrils have already gained an outstanding reputation for:

- Extra-long crawlers, 1350 sq. in. ground contact and knee-action . . . that take bad footing in stride.
- Remarkable ability to shift from straight verticals . . . to high horizontals, 11 feet at the face . . . or to snake holes at ground level.
- The time and step-saving advantages of two sets of grouped controls . . . one at turret, one at boom end.
- Heavy-duty brakes that lock and hold automatically the instant tramming throttle is released.
- You'll want a copy of Bulletin SP-3267 for G-900 specs, operating diagrams and dimensions. Write to:

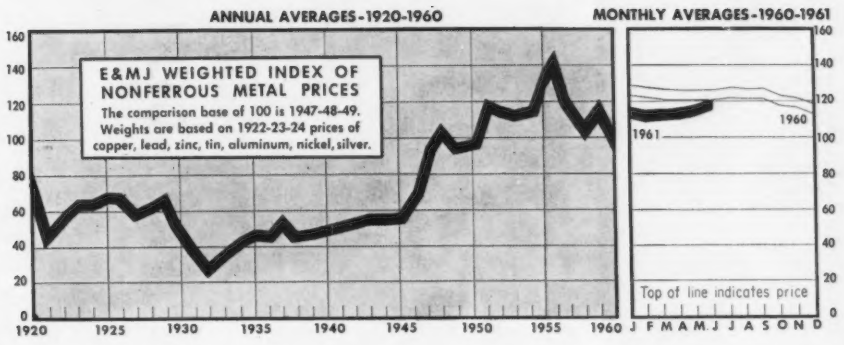
Chicago Pneumatic

8 East 44th Street, New York 17, N. Y.

PORTABLE AIR COMPRESSORS • PNEUMATIC and ELECTRIC TOOLS
CEICHdrills • THREE-CONE AIR-BLAST BITS • ROCK DRILLS

E&MJ OUTLOOK

PRICES


ANNUAL AVERAGES-1920-1960
MONTHLY AVERAGES-1960-1961
E&MJ WEIGHTED INDEX OF NONFERROUS METAL PRICES
The comparison base of 100 is 1947-48-49. Weights are based on 1922-23-24 prices of copper, lead, zinc, tin, aluminum, nickel, silver.
1960
1961
Top of line indicates price
J F M A M J J A S O N D

MARKETS

E&MJ's nonferrous metals price index continued its rise in June, to 120.041 from May's 118.522. And again, tin and copper lead the way, with the latter increasing 0.62¢ and tin jumping 4.54¢. Nickel rose 0.33 over May due to a price rise of 7.25¢, effective June 30.

The annual vacation slump may not be so severe this year. July and August orders in copper seem to be holding, and zinc is looking hopefully toward Detroit, where the 1962 autos (with more zinc content) are expected off the assembly lines earlier, in time to create metal demand in mid-summer.

The expected August price rise in aluminum, almost a sure thing from the vantage point of last March, is now uncertain. Business has not improved at quite the rate that was expected and there is a serious question of timing.

●

AT HOME

A fuel blend of thorium and U-233 has successfully produced a chain reaction in a commercially sponsored nuclear facility, at Atomics International Division of North American Aviation. The AETR reactor, sponsored by 15 Southwest utilities, gets longer fuel burn-up and better neutron economy with U-233.

A lead-zinc stockpile purchase program, "still in the discussion stage" has already met opposition from domestic producers. The plan would authorize purchase of some $65-million worth of Pb-Zn from any source, but only from metal on hand prior to enactment of the program. The opposition to the plan says the program would be: (1) of temporary help at best, (2) of help to producers who use foreign ores since there are no substantial domestic stockpiles, (3) a further drain on U.S. funds. A tariff is called for, they say.

A new alignment with its own copper mine was announced by Continental Copper & Steel Industries, which previously has bought its metal from prime producers. CCS has bought control of Consolidated Halliwell's Sedren mine in Haiti, which has built a 1500-tpd concentrator for the 2.3% Cu ore.

●

LABOR

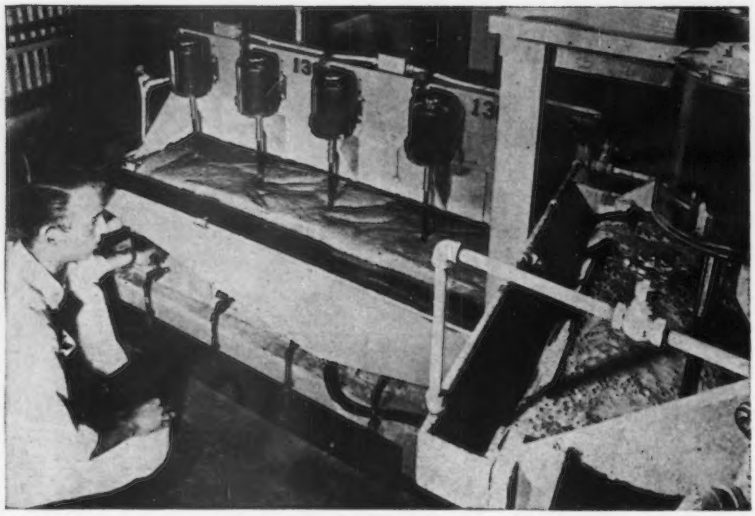
Mine-Mill and the United Steelworkers are now engaged in full battle for representation. The feud dates back to MMSW's expulsion from the CIO eleven years ago and now, with tightened times, has broken out openly. See p 21.

●

ABROAD

Mitsubishi & Co. Ltd. has contracted for 2000 tons of British Columbia lead and zinc from New Ainsworth Base Metals Ltd. It is the first Japanese lead-zinc buy, and follows orders for nearly $200-million worth of BC iron and copper ores. Further expansion by the Japanese in nonferrous ores is expected in western Canada. U.S. smelter operators have protested the damage to custom smelters.

Italy's Montecatini and Madras Aluminum Co. will set up a 10,000-ton aluminum smelter and processing plant at Mettur based on bauxite from the Shevaroy hills. A process developed by the Italian firm will be used, with construction to be completed in 1963 and the smelter onstream in 1964.



PROCESS DEVELOPER Van Dornick, designer Merrill Mac-Afee and Beryllium Resources president Bruce Odlum examine a process analyzer: crucial tools in the process which will be used in a commercial plant to float Mt. Topaz ores.

Beryllium Resources Opens Pilot Plant; UTI Announces Beryllium Corp. Tie

TWO MAJOR beryllium ore producing companies are racing toward commercial production from the recently discovered Topaz Mountain deposits in Southwest Utah. Both claim success for their separation processes; both claim the elimination of U.S. dependence on foreign sources; each is constructing a commercial plant; and each has close ties with a major producer of beryllium metal.

Beryllium Resources, Inc., which opened its pilot plant in Los Angeles to the press in mid-June, is tied to Brush Beryllium Co. Its process, named for Edward Van Dornick, the inventor, uses flotation to separate the disseminated beryllium values from the Topaz Mt. gangue. And Bengt F. Kjellgren, board chairman of Brush, announced one week before the public showing of the pilot plant that his firm had successfully produced metal from the Beryllium Resources ore and ore concentrate. Kjellgren said the metal had been produced in the form of pebbles from BeO which Brush had made from the Beryllium Resources product, and that facilities for such production had been operating at Brush's Elmore, Ohio, plant for the past four months. Beryllium Resources is building a 30-tpm commercial plant, at Delta, at a cost of $2.5-million.

United Technical Industries, which is mining in the same area, uses a "chemical process" to liberate the beryllium oxide and is completing a 15 tpm commercial plant at Delta, due in early July. UTI is tied to the other major beryllium metal producer, Beryllium Corp. Its process was developed by Dr. Paul Cardon, technical director of the Salt Lake firm.

In announcing the joint UTI-Beryllium Corp. venture, Walter R. Lowry, president of the metal-making firm said that it would manage the UTI plant at Delta with a four-man board, two from each firm.

The third contender in the Mt. Topaz-Spor Mt. area is Vitro Chemical Co., a division of Vitro Corporation of America, which is continuing its research on the Utah ores. Vitro has a uranium plant at Salt Lake City which might be used to process the ores.

CO-SPONSORS of a new joint venture are Walter Lowry of Beryllium Corp. and UTI's Vincent Duff.

The New Pilot Plant

At the news conference in Los Angeles in mid-June, Bruce W. Odlum, president of Beryllium Resources, drew a parallel between the sudden development of domestic resources of beryllium with the evolution of uranium in the U.S.

"The beryllium industry began in 1931 and has just about doubled in value every year since then," he said. "Consumption, in the form of beryl, started with two tons in 1931 and had increased to 10,400 tons by 1960 for U.S. industry alone.

". . . That progression would have taken place much more rapidly," Odlum believes, "if known and proven reserves of beryllium ores could have been counted on during those years."

Odlum named Dr. Norman Williams and Mr. Van Dornick as two pioneers whose belief in the Topaz ores and in the flotation process respectively brought the new plant into existence.

The full scale commercial plant, Odlum said, will be completed by Beryllium Resources at the end of 1961. Other plants, serving other types of beryllium ores, are under study in various parts of the world.

He emphasized that greater availability is expected to bring lower prices and wider use of the versatile metal.

In the Van Dornick flowsheet, to be

described in detail in a forthcoming issue of E&MJ which will up-date our Beryllium report of September 1960, the following basic steps occur:

1. Crude ore is prepared in crusher, rolls, ball mill and a classifier.
2. Mineral dressing begins in a conditioner with ore, water and conditioning chemicals agitated.
3. Desliming removes minus-5 micron materials.
4. Underflow (deslimed pulp) is filtered and re-conditioned. Overflow goes through slime disposal system.
5. By-product mica and feldspar are removed in the initial flotation system. By-products are thickened, filtered and conditioned in separate circuit.
6. Beryl-containing material is thickened, filtered and conditioned and beryl flotation reagents introduced.
7. Product goes through rougher circuit, six cleaners, and the finished concentrate is thickened and filtered. Silica tails go to waste.

The Beryllium Resources pilot plant represents an investment of $750,000 exclusive of the costs of development of the Van Dornick reagent, owned by Hydrocarb, his own firm. Recovery from the flowsheet is said to be 85%, and further improvements are expected, both in recovery and in possible elimination of some of the process steps.

And in Nevada

Anaconda is pushing development of the Mt. Washington district beryllium property southeast of Ely, Nev., according to Clyde E. Weed, chairman of the board.

Mr. Weed said that Anaconda needed to develop a "million or so tons" of beryllium ore at the properties in order to meet its expectations as to size. Owners of the properties had developed an estimated 100,000 tons of beryllium ore at time of option to Anaconda.

Anaconda has two years in which to delineate reserves and Mr. Weed said this wasn't much time in which to develop a major mine — hence the reason for the vigorous approach.

Mr. Weed said that Anaconda, if beryllium work justifies, would aim at producing a very high purity beryllium metal.

He said that to date only one firm — and that an English concern — produces beryllium metal which meets specifications of the U. S. Atomic Energy Commission.

He said that the goal of the beryllium metal makers ought to be a metal of 99½% purity. Such purity imparts a ductility to the metal which lower purity beryllium metals do not have. As a consequence, these metals with less than 99½% Be are brittle and difficult to work and machine, he said. This brittleness has been one of the problems of developing the beryllium industry.

(This Month continues on p 100)

As We Went to Press . . .

Cerro Corp. has optioned 1030 acres at Wauna, Ore. at a deep-water port on the Columbia River for a proposed 55,000-ton single potline aluminum smelter. An agreement has been signed with the Bonneville Power Administration for delivery at the site, some 42 miles from the mouth of the Columbia. Officials says the total investment may run up to $50-million.

Negotiations between M. A. Hanna and the Brazilian government for private industry shipping of a potential 20-million tons of ore from Minas Gerais state were under way. Witnesses before government hearings have almost unanimously advised against government-controlled operations, but nationalistic groups within Brazil have been bringing pressure on new president Janio Quadros.

Col. Willard T. Chevalier, executive vice president of McGraw-Hill and a former publisher of E&MJ, died June 29 at the age of 75. Col. Chevalier had also been publisher of BUSINESS WEEK and other McGraw-Hill magazines, and was publisher of EM&J from 1934 to 1938.

Dawn Mining Co. has optioned a copper property on the Colville Indian Reservation and plans diamond drilling and stripping this summer. The firm, a subsidiary of Newmont Mining Corp., now runs a 400-tpd uranium mill at Ford, Wash., and operates uranium properties on the Spokane Indian Reservation.

Exploration and mining has been resumed on the Dahl lease, Mt. Spokane, Wash., by Daybreak Uranium Inc. Operations had been curtailed at the property last fall but the firm shipped 248 tons of ore from stockpile to the uranium mill at Ford, Wash. A three-man crew will mine ore from a deposit opened last year.

Two tin smelters will be built this year on the Bauchi Plateau, Nigeria's tin producing region. The first, in initial production since last March, will turn out 24-tpd metal from eight furnaces by the end of the year. It is being built by Nigerian Embel Tin Smelting Co. Ltd., a Portuguese firm.

The second, now under construction, is being built by Makeri Smelting Co. Ltd., a British firm controlled by Consolidated Tin Smelters. Production from the 30-tpd plant will begin in August.

Competitive nuclear power by 1968 from large-scale plants in high-cost energy areas of the US is now the goal of the AEC, according to commissioner Loren K. Nelson. These plants are likely to be 300 to 375 megawatt pressurized-water or boiling-water types (both use enriched uranium) and should produce power for 6 to 7 mills per kilowatt-hour.

This means that within the next two years some companies will be faced with go-ahead decisions on building the plants. Companies expressing interest in competitive nuclear power include Southern California Edison Co., Pacific Gas & Electric Co. and a group of New York State utilities.

Reynolds Metals Co. is negotiating with the Surinam government for the development of a 200-million deposit of bauxite located on the Corantijn River in western Surinam. Reynold's geologists are presently taking a look at the deposit.

WASHINGTON IMPACT

Highlights

MORE AND MORE, Washington's policies on international metal-mineral problems are being tied to developments in Latin America. For that reason, several aspects of U.S.-Latin relationships are being closely examined in Washington to determine their effects on the industry.

New perils and possibilities have arisen in the Dominican Republic, where Alcoa's bauxite operations and other potential mining and processing operations are involved.

The U.S. hopes to see the rise of a new government which can work its way back into the good graces of the Organization of American States. OAS, the 19-nation hemispheric body, severed relations with the Dominican Republic during the Trujillo regime and the U.S., as an OAS member, imposed some trade sanctions on the Caribbean state.

After Dominican president Joaquin Balaguer and Gen. Rafael Trujillo Jr., pronounced their control of the Dominican Republic, the U.S. had grave fears that a business-as-usual regimen would continue. But an OAS committee, appointed to determine whether conditions in the Dominican Republic had sufficiently improved to allow the country to rejoin the Organization, reported favorably on the situation in its initial check and paved the way for renewed relationships.

U.S. officials privately remain doubtful, however, on the aims of the Balaguer-Trujillo Jr. government. The U.S. will move cautiously in recognizing that group. Meanwhile, the covert hope of top U.S. officials is that a new government, genuinely amenable to western hemisphere interests, will gain control. About all the U.S. expects is a benevolent dictatorship, perhaps through a coup by lower-ranking moderate militarists.

The U.S. thinking is that a continued Trujillo-type regime, whether or not friendly to U.S.-controlled mining operations and other American investments in the country, would be harmful to the long-range goal of instituting democratic processes throughout Latin America and holding the area from Soviet bloc influence.

ANOTHER TROUBLE SPOT is Bolivia. The Soviet Union has made a grandiose offer to bolster the South American country's tin mining operations with money and technical advice.

The Bolivian government dragged its feet on the Russian offer, waiting instead for a U.S. commitment to help mining processing, which Bolivian Government officials believed would be more advantageous than funds dedicated to basic mining operations.

But the Castro influence has extended to Bolivia, and there have been demonstrations and abortive attacks against the Bolivian government. One of the more serious occurred when Adlai Stevenson, U.S. Ambassador to the United Nations, was in Bolivia on a good-will mission recently.

The U.S. in June announced a rehabilitation program for Bolivian mines to be operated under the Inter-American Bank. Under the program, the U.S., West Germany, and the Bank agreed to lend $11.5-million to Bolivia for first-stage funds in the rehabilitation of the Corporacion Minera or Combol, the state mining operation.

The Inter-American Bank guaranteed $4-million, West Germany $3.75 million, and the U.S. $3.5-million for Bolivian mining. The U.S. loan is part of a larger amount of $10-million which the U.S. had already committed to Bolivia's mining industry, however.

But there were troublesome diplomatic reports in the U.S. that the Bolivian financing may have been too little and too late. These reports were so forceful that one U.S. international metal decision was held in abeyance until the Bolivian domestic political situation settled.

In that instance, the International Tin Council had asked the U.S. to release from its stores about 4,000 tons of surplus tin held by the General Services Administration in Texas City, Texas.

The Tin Council hoped to get release of the tin before world prices of the metal rose to the point that the Council's tin pool manager, under terms of the International Tin Agreement, would have to sell from the pool to help keep prices from rising further.

But Bolivians would be sure to protest any effort to restrict the price of tin, a major commodity of the country. In the framework of domestic political turmoil in Bolivia, the U. S. reasoned that sale of the surplus tin would only invite more trouble in the South American country.

Bureau of Mines Plans Reactor for Mineral Study

THE INTERIOR DEPARTMENT'S Bureau of Mines has announced plans for building an atomic research facility at Albany, Ore., to study minerals and mineral fuels. The new structure is scheduled for completion within the next 12 months. It will house 100,000 curies of cobalt-60, to be supplied by the Atomic Energy Commission. The radioactive isotope will be used in basic research to determine effects of gamma radiation on physical and chemical properties of many metallic and non-metallic minerals.

Scientists believe gamma irradiation may help advance mineral technology either by changing the properties of minerals and fuels so they can be processed more easily, or by actually speeding chemical reactions in mineral-treating processes. Small-scale studies by the Bureau of Mines already have indicated that both approaches—property changes and hurried chemical reactions—are promising.

The gamma-ray source at Albany will consist of 24 strips of radioactive cobalt, each doubly sealed in capsules of stainless steel and aluminum. When not in use, they will be stored under 17 feet of water in a deep well. When needed for research, the capsules will be raised into a cell-like structure with four-foot thick walls of heavy-density concrete.

Although radiation will be present inside the cell, materials removed from the cell will have no residual radioactivity. This fact, plus the incorporation of safety features in the design and the use of proper operational methods, is expected to make the plant safe from potential radiation hazard.

Interior Adopts New Rules For Phosphate Prospecting

NEW PHOSPHATE PROSPECTING rules adopted by the Interior Department are aimed at substituting a prospecting permit-lease system for the old competitive lease method.

Secretary of Interior Stewart Udall said that under the new regulations, phosphate prospecting and development on Federal lands will be conducted under the same systems used for coal, sodium, sulphur, and potassium.

The new rules provide for issuance of two-year prospecting permits covering up to 2560 acres each. An annual rental of 25c per acre will be charged for lands under prospecting permits. The acreage limitation of 10,240 acres for phosphate leasing will also apply to prospecting permits and leases.

Udall said the requirement for permit rental is consistent with the resource fee policy outlined by President Kennedy in his Natural Resources Message to Congress in February.

Under the new rules, a person or company holding a prospecting permit will have exclusive rights to look for phos-

phate on the area covered by the permit. The permit could be extended for up to four additional years. If a valuable deposit of phosphate is discovered, the person holding the permit will have the right to lease the land containing the deposit.

Amendments of the prospecting rules were first proposed and published in October 1960. After 30-day notice for public comment, a public hearing was held on the proposed rules in March. Some minor adjustments were made in the final rules as a result of the hearing.

Industry Attacks Plan For Foreign Mines' Tax

MINING INDUSTRY SPOKESMEN have protested the Administration's plan for taxing undistributed profits of foreign subsidiaries. Industry testimony before the House Ways and Means Committee held that the proposed tax treatment would seriously handicap companies owned by U.S. stockholders in competition with foreign producers in foreign markets.

Lincoln Arnold, chairman of the American Mining Congress' tax committee, asked the House group for additional studies both by the Administration and by Congress before the tax change is adopted. Arnold said the Kennedy proposals would curb the growth and expansion of U.S. enterprise in foreign countries, adding that Canada, for example, probably will withdraw its tax exemption for U.S. owned mines if the U.S. starts collecting taxes on undistributed profits during the first year of a new mine's operation.

Canada presently offers a three-year exemption from taxes on a new mine. Under the Kennedy proposal, the mine would be subject to U.S. taxation starting the first year.

Congress Wary of New Threats to Depletion

MINING-STATE lawmakers are guarding against any effort to extend an expected attack on oil and gas depletion to metals.

Senator John J. Williams (R-Del.) has introduced his annual bill to reduce the oil and gas depletion allowance from its present 27.5% to 20%.

Congressmen from mining areas do not believe Williams' effort will trouble metal and mineral depletion rates, but do not want to take their position for granted.

They are especially wary of a depletion attack this year because of a democratic platform plank embraced by President Kennedy to close any depletion "loopholes" in tax laws.

Another point of worry among some House and Senate members was a recent speech by Robert C. Tyson, chairman of U.S. Steel Corp.'s finance committee. Tyson maintained that there is no such thing as "tax incentives." "Any tax at all is a deterrent, or a 'dis-incentive,'" Tyson said.

Labor This Month

NONFERROUS UNION FEUD EXPLODES: the Mine-Mill and Smelter Workers-United Steelworkers rivalry has erupted into a full-fledged verbal war. For eleven years, since Mine-Mill's expulsion from the old CIO and the Labor Federation's award of nonferrous jurisdiction to the Steelworkers, the two unions have fought one another for members and representation right throughout the industry.

Last month, the contest grew even hotter. Mine-Mill fired the first shot. In an open letter to USW president David J. McDonald, MMSW president John Clark accused the AFL-CIO union of seeking to "seduce" Mine-Mill members and staff workers by "special financial inducements . . . that amount to indirect bribes. It is a disgrace to the union movement," Clark charged. The Steelworkers countered, in a special 25th Anniversary report: "The eyes of USW never drop from its objective; to bring the benefits of strong unionism to all who work in the jurisdiction . . . not only to bring Mine-Mill members into the USWA family but mainly to organize the thousands yet without benefit of a union in this field."

LABOR POLITICAL WINGS CLIPPED: when the Supreme Court last month ruled that railroad workers could refuse to have their dues money used in their union's political program, it opened the way for a series of challenges against labor political activity. The High Court case dealt only with one aspect of the issue—the union shop clause in the Railway Labor Act where workers are required to become union members within 30 days to hold their jobs. A five-man majority of the court held that while the railroad employee had to join the union, he did not have to support its political campaigns. Up to now, rail unions have used their dues treasuries to support political candidates—whether or not an individual member agreed with their choice.

The next step is likely to be a spate of legal challenges against the political programs of industrial unions—which come under the Taft-Hartley Act. The Supreme Court move is a special blow because of the build-up of political activity by union leaders. Besides funnelling off funds from such programs, the court decision allows the minority political voice of the union member, which had been effectively stilled up to now, to be heard.

MINE-MILL DELAYS BARGAINING SHOWDOWN: MMSW officials agreed to run past their contract deadline with Kennecott Copper Co.—without a new contract. Though they weren't saying so publicly, it's likely Mine-Mill negotiators wanted a long look at the bargaining between Walter Reuther's United Auto Workers and the auto makers before making their own settlement. If Reuther scores in Detroit, it's almost sure to firm up Mine-Mill's demands with Kennecott. The nonferrous union wants higher wages and supplementary unemployment benefits plus a host of fringes. Reuther's auto demands are even greater. However, besides the auto producers, Reuther faces a warning from the White House against "excessive" wage settlements. The Administration position could dampen the settlements of both the UAW and Mine-Mill.

RETRAINING FOR AUTOMATION AGE: the Kennedy Administration is taking an admitted—but it believes necessary—gamble that workers displaced by automation can be retrained for the skills demanded by modern industry. It is asking Congress for authority to tap the unemployed worker for new training assignments, as well as the funds to support the special schooling. The cost: $700-million over a four-year period. The program would provide:

On-the-job training with Federal funds used to supplement employer payments up to $46 weekly for a maximum 52 weeks.

Vocational training for selected workers to be paid by the Government at a rate not exceeding unemployment compensation payments in their particular states. This, too, would run for a year.

The gamble is this. Workers covered by the plan are the first to lose out to automation—the unskilled, minority groups, youths and older workers. They make up the "hard-core" unemployment, now around three-million who find it toughest to get and hold jobs. Even with this broad program, the Administration expects to successfully train only 50,000 to 60,000 workers annually. But unless something is done, Federal officials believe the totals of permanently unemployed will soar.

MARKETS

Good Business, Labor Threats Buoy Copper; Zinc Discounting Continues; Tin Market Unruly

THE E&MJ INDEX OF NONFERROUS Metal Prices in June was 120.0% of the 1947-49 average, rising from 118.5% in May. Tin prices continued their uncontrolled climb and were on the average 4½c higher in June. Copper—which is more heavily weighted—rose more than 0.6c during the month. Nickel was boosted 7¼c, but was effective only one day in June.

Domestic copper prices in June were steady at 31c a lb delivered. Sales at above this level were reported and included in daily averages only during the second market week of the month. Merchant sales to consumers were as low as 30⅝c, as high as 31¾c.

The London pace eased a little during the month with the cash average down £6. An early-month decline was regarded as a technical adjustment after too fast a rise. Thereafter fluctuations were limited.

World market undertone was firm. That U.S. fabricators were experiencing a definite resurrgence was emphatically indicated in May statistics. Shipments of 145,800 tons of contained copper were the highest in 16 years, and bookings of new business the best since March 1959. Stocks fell 14,500 tons.

Primary data showed world refined output up 26,000 tons, deliveries up 17,000 and stocks off 18,000 tons.

Along with good business, and to an extent responsible for it, a variety of labor and political threats to world output keep the market firm. In the Congo, Katanga Province head Moise Tshombe was reported having reneged on various of his agreements concerning provincial unity made while a prisoner of the central government. Shipments from Katanga are reported back on the all-Congo route for the time being. Tshombe's secessionist ideas keep the threat of civil war constant.

In Rhodesia, where the Copperbelt is centered, natives have threatened a genral strike unless the new constitution is revised to give them greater power in the Legislative Council.

In the U.S., Kennecott Copper's contract with the Mine, Mill and Smelter Workers ran out on June 30. An agreement had not been reached at that time, but the company was expecting output on a day-to-day basis through July when USW contracts with the company ran out. Mine-Mill and Kennecott settled July 1.

Anaconda negotiations with Chilean workers at Potrerillos and El Salvador (6,500 tpm) were to be placed before the Copper Conciliation Board on July 7. The contract ends July 31.

Though no agreement had been reached on the June 30 expiration date, Amax (12,500 tpm and 10,000 fire refined) and Mine-Mill were expected to get together shortly. Again, workers were expected to work through July contract or not. They settled on July 1.

At this writing differences between shippers and maritime unions were nearly resolved. Foreign-flag ships were able to take up the slack during the walkout.

The pickup in aluminum activity has slowed in recent weeks to the extent that the industry is no longer counting on an increase in primary prices come August when labor increments go into effect. Feeling is that the industry is still recovering from the second-half 1960 slump and is not yet ready for the oft-postponed boost. A 1.1c cut in extrusion billet quotes was a move in the opposite direction.

May primary output was 157,544 tons or 74.7% of capacity, compared with 144,637 (70.8%) in April. The U.S. was a net importer of metal in March for the first time since October 1960.

Domestic shipments of zinc rose for the sixth consecutive month in May to 76,000 tons. Stocks declined 6,000 tons. Sales of Prime Western to the galvanizing industry were particularly encouraging, but premium quality metal was having its trouble. Belief that production of 1962 automobiles would begin earlier this year, perhaps in late July or August, has given some hope for improved die casting demand.

The cut last month in the paper price of HG and SHG premiums has failed to halt discounting, particularly SHG. Premium grade prices are in the uncomfortable position of squeezing down on the healthy Prime Western market. Quoted premiums are strictly nominal. Discounting is futile, many believe, since it fails to lure customers away and slashes profits for everyone.

Lead sales have held up better than expected, and, as is the case with zinc, the metal's price is expected to hold through the vacation period of July and August. Word of barter deals for Canadian and Australian surpluses with others reported on the way has fostered a belief that normal fall activity could bring a price rise.

The Administration has loosed a trial balloon on the lead-zinc industry in the form of a stockpile purchase proposal. Under the plan the Government would buy $65-million worth of U.S. stocked metal, regardless of origin, with money gained from the sale of farm surpluses. Metal from U.S. origin ore would be limited to that on hand at the time of enactment. A free silver market was also suggested.

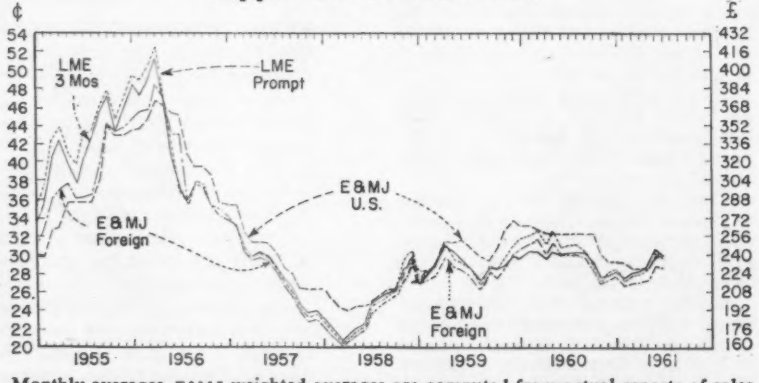
The primary criticism by U.S. producers is that in the long run the major trouble spot—excess imports—would not be remedied. The Administration is pledged to support foreign producers and is shying away from further tariff aid.

Observers see Congress anxious to do something. Anything at all in combination with satisfactory barter should lead prices in the fall.

Tin prices, which had risen steadily throughout May, continued to climb in June. Early in the month, the LME reached £880 and the Buffer Stock manager was forced to sell freely. He checked prices for about two weeks before a few large London dealers decided to buy out the remainder of the Stock.

Prices then skyrocketed, hitting highs of £936½ in London, and 120c in New York. Both markets eased, however, as the month ended. The heavily speculative LME fell sharply on reports that the U.S. is going to release almost 4,000 tons of stockpile tin, despite State Department fears of an unfavorable political reaction in Bolivia. Other bearish factors include better Malayan output and an improved political picture in the Congo, whose production has been cut off since January 16.

Copper Prices 1954-1961



Monthly averages. E&MJ weighted averages are computed from actual reports of sales to E&MJ — normally 140,000 to 170,000 tons per month. LME prices are the average of the mean of the bid and asked; they refer to long tons. The two scales are equal at an exchange rate of $2.80 per £. £320 is 40c a lb, etc. Data through June 1961.

Average Prices June (E&MJ Quotations)

Cents per lb unless otherwise indicated:	
Copper:	
Electro, domestic refinery	30.605
Electrolytic, exports refinery ..	28.701
Electrolytic, c.i.f. Cont'l ports .	29.646
Lead:	
Common, New York	11.000
Common, St. Louis	10.800
Silver:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz. .	79.375d
Zinc:	
Prime, Western, East St. Louis	11.500
Prime, Western, delivered (g) .	12.000
Tin:	
New York Straits	114.648
Gold, per oz., U.S. price ...	$35.000
Sterling Exchange	278.981
Quicksilver, per flask $200.455	
Antimony, (E&MJ) (d) ...	36.250
Antimony, bulk, Laredo ...	32.500
Antimony, in cases, Laredo .	33.000
Antimony for, 99% (h)	28.125
Palladium, troy oz.	$24.000
Platinum, refined, per oz. ..	$82.000
Cadmium (a)	160.000
Cadmium (b)	170.000
Al 99½% unalloyed ingot .	26.000
export, ingot	23.250
Magnesium, ingot	35.250
Nickel (f)	74.330
Bismuth	$2.250
Cobalt	$1.500

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quick-silver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

Free Gold Market

During June gold sales in international markets declined 7.6%. Prices of the yellow metal showed only minor changes, but rose 20% in terms of local currency in South Africa. Gold coins, briefly minted in Europe, continued to be sold abroad at high prices. Russian gold sales of about $28-million were reported from London. The volume of gold futures rose slightly and averaged about $750,000 daily. Premium rates increased fractionally listing at 4¾% p.a. against dollars and 3¾% against Swiss francs or DM for six months delivery. One year contracts were available at ½% higher interest. The U.S. gold stock rose $147-million during June to $17.550-billion. PICK'S WORLD CURRENCY REPORT quotes on "free gold" per fine oz as follows:

	Coins		Bars (12.5 kg)	
	May 31	June 30	May 31	June 30
New York transit.			$35.10	$35.10
Manila.....	$41.30	$41.35	35.95	36.00
Hong Kong.....	48.75	48.65	38.75	39.50
Bombay.....	56.60	56.30	53.25	53.00
Beirut.....	40.10	39.90	35.23	35.26
Paris.....	40.10	40.17	35.60	35.62
Buenos Aires.....	40.65	40.75	36.40	36.40

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of June reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛¢; ¼¢ deducted for selling common.

Delivered consumer's plant	30.750 lb
F.o.b. refinery	30.350 lb

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

June 1961	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (e)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Unalloyed Ingot 99%	Straits Tin New York
1	30.600	29.300	30.295	11.000	10.800	12.000	11.500	26.000	111.125
2	30.600	29.175	30.120	11.000	10.800	12.000	11.500	26.000	111.125
5	30.600	29.250	30.195	11.000	10.800	12.000	11.500	26.000	111.250
6	30.600	28.975	29.920	11.000	10.800	12.000	11.500	26.000	112.125
7	30.600	29.050	29.995	11.000	10.800	12.000	11.500	26.000	112.375
8	30.625	28.900	29.845	11.000	10.800	12.000	11.500	26.000	112.750
9	30.625	29.025	29.970	11.000	10.800	12.000	11.500	26.000	113.000
12	30.625	29.075	30.020	11.000	10.800	12.000	11.500	26.000	112.875
13	30.625	28.825	29.770	11.000	10.800	12.000	11.500	26.000	112.750
14	30.600	28.825	29.770	11.000	10.800	12.000	11.500	26.000	112.375
15	30.600	28.725	29.670	11.000	10.800	12.000	11.500	26.000	112.125
16	30.600	28.500	29.445	11.000	10.800	12.000	11.500	26.000	112.500
19	30.600	28.375	29.320	11.000	10.800	12.000	11.500	26.000	113.000
20	30.600	28.075	29.020	11.000	10.800	12.000	11.500	26.000	116.125
21	30.600	28.125	29.070	11.000	10.800	12.000	11.500	26.000	117.000
22	30.600	28.525	29.470	11.000	10.800	12.000	11.500	26.000	117.250
23	30.600	28.775	29.720	11.000	10.800	12.000	11.500	26.000	120.000
26	30.600	28.350	29.295	11.000	10.800	12.000	11.500	26.000	119.500
27	30.600	28.325	29.270	11.000	10.800	12.000	11.500	26.000	119.250
28	30.600	28.350	29.295	11.000	10.800	12.000	11.500	26.000	119.125
29	30.600	28.475	29.420	11.000	10.800	12.000	11.500	26.000	118.250
30	30.600	28.375	29.320	11.000	10.800	12.000	11.500	26.000	116.375
AVERAGES FOR MONTH									
June	30.605	28.701	29.646	11.000	10.800	12.000	11.500	26.000	114.648
AVERAGES FOR WEEK									
June 7	30.600	29.160	30.105	11.000	10.800	12.000	11.500	26.000	111.600
14	30.620	28.930	29.875	11.000	10.800	12.000	11.500	26.000	112.750
21	30.600	28.360	29.305	11.000	10.800	12.000	11.500	26.000	114.150
28	30.600	28.465	29.410	11.000	10.800	12.000	11.500	26.000	119.025
CALENDAR WEEK AVERAGES									
June 2	30.619	29.470	30.415	11.000	10.800	12.000	11.500	26.000	111.219
9	30.610	29.040	29.985	11.000	10.800	12.000	11.500	26.000	112.300
16	30.610	28.790	29.735	11.000	10.800	12.000	11.500	26.000	112.525
23	30.600	28.375	29.320	11.000	10.800	12.000	11.500	26.000	116.675
30	30.600	28.375	29.320	11.000	10.800	12.000	11.500	26.000	118.500

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U.S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

(e) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance. Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U.S. lead is corroding grade).

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

June 1961	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
1	91.375	79.375d.	279.0625	251s. 4d.
2	91.375	79.375d.	279.0440	251s. 4¼d.
5	91.375	79.375d.	279.0920	251s. 4d.
6	91.375	79.375d.	279.0620	251s. 3⅞d.
7	91.375	79.375d.	279.0100	251s. 4d.
8	91.375	79.375d.	278.9460	251s. 4¼d.
9	91.375	79.375d.	278.9800	251s. 4d.
12	91.375	79.375d.	279.0260	251s. 3⅞d.
13	91.375	79.375d.	279.2200	251s. 2d.
14	91.375	79.375d.	279.3640	251s. ⅛d.
15	91.375	79.375d.	279.2080	251s. ¾d.
16	91.375	79.375d.	278.7480	251s. 3⅛d.
19	91.375	79.375d.	278.8975	251s. 5d.
20	91.375	79.375d.	278.8860	251s. 5¼d.
21	91.375	79.375d.	278.8325	251s. 5⅛d.
22	91.375	79.375d.	278.8475	251s. 6⅛d.
23	91.375	79.375d.	278.7875	251s. 6⅛d.
26	91.375	79.375d.	279.0000	251s. 6⅛d.
27	91.375	79.375d.	279.0450	251s. 4⅛d.
28	91.375	79.375d.	278.9220	251s. 4⅛d.
29	91.375	79.375d.	278.8360	251s. 8d.
30	91.375	79.375d.	278.7640	251s. 8½d.
AVERAGES FOR MONTH				
June	91.375	79.375d.	278.981	—
AVERAGES FOR WEEK				
7	91.375	—	279.054	—
14	91.375	—	279.107	—
21	91.375	—	278.914	—
28	91.375	—	278.920	—

Calendar Week Averages: New York Silver: June 2 91.375; June 9, 91.375; June 16, 91.375; June 23, 91.375; June 30, 91.375.

MARKETS *(Continued)*

London Metal Exchange Quotations

June 1961	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
1	240	240½	242½	242¾	65½	65¼	66⅜	66½	81½	81⅝	82¼	82½	869½	870	876	876½
2	239	239¼	241½	242	64⅞	65⅛	65⅝	66	81½	81⅝	82⅝	82⅝	867	868	874½	875
5	239¼	239½	242¼	242½	64⅝	64½	65⅝	65¾	81	81⅛	81⅝	82	869	871	875½	876
6	238¾	238½	241¾	241½	64⅝	64⅝	65⅞	66	81	81⅛	81⅝	82	877	878	880½	881
7	237	237¼	240	240¼	64½	64⅝	65¾	66	80¼	80⅝	81¼	81½	879½	880	888	889
8	238	238¼	240½	240¾	64⅝	64⅞	66	66⅛	80¼	80⅝	81⅛	81⅜	879½	880	890	891
9	239¼	239½	241¾	242	63¾	64	65	65⅛	79¼	79⅞	80¼	80⅞	879	880	890	890½
12	239¾	240	242½	243	63⅝	63¾	64⅞	65	78⅞	79	79⅞	80	879½	880	889½	890
13	237	237¼	239½	239¾	64⅜	64½	65½	65⅝	78¾	78⅞	79¾	79⅞	879½	880	888	888½
14	237¼	237½	240	240¼	64⅝	64⅝	65⅝	65¾	78¾	78⅞	79¾	79⅞	879½	880	888	888½
15	235¼	235½	237¼	237½	63½	63⅝	64⅝	64¾	77⅝	78	79	79⅛	879½	880	887½	888
16	234¾	235	237½	237¾	64⅛	64¼	65⅜	65½	77⅝	77¾	78⅝	78⅞	879½	880	889½	890
19	234	234¼	236¾	237	64¼	64⅜	65½	65⅝	78	78⅛	78¾	79	879½	880	893	893½
20	231½	231¾	235	235¼	64⅛	64¼	65½	65⅝	77	77¼	78⅛	78¼	879½	880	894½	895
21	234¾	235	238¼	238½	63⅞	64⅛	65½	65⅝	77	77⅛	78⅛	78¼	902½	905	913	914
22	238¾	239	242	242¼	64⅛	64⅜	65½	65¾	77¾	78	78¾	79	915	916	924	925
23	235	235¼	238¼	238½	64¾	65	66	66⅛	77¾	77⅞	78¾	79	930	931	935	936
26	234¼	234½	238	238¼	65	65¼	66⅜	66½	77⅝	77¾	78⅝	78¾	933	934	937½	938
27	234	234¼	237¾	238	65¾	66	66⅞	67	78¾	78⅞	79¾	79⅞	927	928	930	930½
28	234¼	234½	238¼	238½	66½	66¾	67¾	68	79	79⅛	80¼	80⅜	936½	937	938½	939
29	236	236¼	239¾	240	66⅛	66¼	67⅛	67½	79⅛	79⅜	80¼	80⅜	921	922	926	927
30	232½	232¾	236½	236¾	65	65⅛	66⅜	66½	78¼	78½	79½	79¾	914	915	918	918½
Av'g's	£236.483		£239.545		£64.699		£65.943		£79.045		£80.054		£893.886		£901.523	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.0%, zinc 98% and tin min. 99.7%.

Miscellaneous Metals, Ores, Minerals

Quotation cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

MISCELLANEOUS METALS

June 30, 1961

Aluminum ingot, 99.9% lb		28c
Antimony, spot, lb. less than carload, in cases		36.250c
In bulk, carload lots, f.o.b. Laredo		32.5c
Imported, 10 ton min. (p), 99% Duty not paid	28c —	28.25c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.60
small lots		$1.70
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 99.8% grade, lb, contract delivered	$1.15 —	$1.19
Cobalt, 97 to 99%, per lb effective 3-1-60		$1.50
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)	29.95c
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		81¼c
Other sales, regular sellers		81¼c
Sales by dealers, etc.		81¼c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16		35.25c
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$80 —	$85
Quicksilver, flask of 76 lb, 25 flasks or more	$200 —	$203
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$6.50 —	$7.50
Silicon, minimum 98%, carloads, lb		19c
Semi Conductor grade, lb., lump		$360
Tellurium, lb		$5.25
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective Dec. 6, 1956; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu; spot	$32 —	$33
term contracts	$34 —	$34.50
Chrome ore per long ton, f.o.b. cars Atlantic ports, dry:		
44% Cr_2O_3 no ratio	(a)$19.75 —	$20.50
48% Cr_2O_3 3 to 1 ratio	$35¾ —	$38
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.85(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$125.16
Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.		
Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.40
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 65%, c.i.f. U. S. ports, duty extra	$15.25 —	$15.75
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton.		$68

(a) Nominal. (b) c.i.f. U. S. ports. (e) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4c
Cobalt, oxide, 72½% to 73½%, per lb, effective Mar. 1, 1960	$1.15 —	$1.18
Copper sulphate, 100 lb, effective 5-17-61		$12.50
Germanium dioxide, gm		16¾c
Molybdic trioxide, technical, per lb of Mo	$1.59 —	$1.60
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo. lb of Mo contained	$1.63 —	$1.95
Ferrosilicon, 50% per lb of Si f.o.b. shipping point		14.60c
Ferrotungsten, 72 to 82%, lb of W contained		$2.25
Ferrovanadium, per lb of V delivered	$3.20 —	$3.40
Silicomanganese, max., 1½% C, lb contracts		11.6c
Spiegeleisen, per lt, 19-21% grade	$98 —	$101

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper stock	$120–$142
Crude No. 2	$750–$1,155	Waste	$75– $86
Spinning Fibers	$370– $600	Shorts	$40– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$470–$787
Asbestos, Vermont, f.o.b. Morrisville:		Shingle fibers	$142–$325
Spinning fibers	$353– $408	Waste, stucco or plaster	$86
Shingle stock	$181– $218		
Paper stock	$120– $142	Refuse or shorts	$41– $75

Barytes, f.o.b. cars:		
Georgia, crude, per ton		$18
Missouri, 94%, $BaSO_4$, per st	$16 —	$18
Crude oil well grade, min. 4.3 sp gr, st (a)		$18
Imported, c.i.f. Gulf Ports, st	$12½ —	$14
Bauxite, st, f.o.b. point of shipment:		
Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% Al_2O_3, 6% SiO_2, 1.25% Fe, 1-1-60		$7.25
Feldspar, bulk ton; f.o.b. plants:		
Potash or soda feldspar, 200 mesh, ceramic grade	$17 —	$20.50
Glass feldspar, white, 20 mesh		$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —	$41
60% effective CaF_2	$33 —	$36
Acid 97% concentrate, bulk, ton f.o.b. Ill.	$45 —	$50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington		$46

Mica—Domestic, f.o.b. mines. Punch 7c-12c per lb according to size and quality. Sheet clear 1½x2 in. 70c-$1.10; 2x2 in. $1.10 to $1.60; 2x3 in; $1.60-$2.10; 3x3 in, $1.80-$2.30; 3x4 in, $2.00-$2.60; 3x5 in, $2.60-$3.00, 4x6 in, $2.75-$4.00; 6x8 in, $4.00-$8.00. Wet ground, very fine, $140-$155 per ton, Bulk sales, dry ground; $30-55 per ton. Scrap $20-$30.

Ocher, Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, Mexican, for use in Mexico, metric ton, f.o.b. mines, depending on location	$21 —	$23
For export f.o.b. vessel, depending on grade	$22.50 —	$23.50

Actual prices received by U. S. producers approximate the Mexican export prices.

Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50; (b) Corrected; (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

VIBURNUM PLANT: Solid step into the future.

St. Joseph Lead Co., well known for progressiveness—and achievement—in the use of methods, equipment and technology, has made a great advance with its new Viburnum project in Southeastern Missouri.

Teamwork, imagination-and experience

Viburnum, which includes three mines, a mill, and modern community, is a product of sound planning, the combined efforts of men and their experience at work. Technical know-how, knowledge gained in a long history in the Lead Belt and other operations, plus ideas from working personnel, have produced unique methods, equipment and automated process control systems which make the new operation unparalleled for efficiency.

Wemco-Fagergrens for flotation

In the milling section, four banks of Wemco-Fagergren 66″ x 60″ 7-cell machines were selected for roughing and four 2-cell 66″ units with Pumper Cell closure for cleaning duty.

Minimum floor space required

Wemco-Fagergren machines save on valuable floor space because "Fags" are proved more productive per square foot of area. Premium savings, too, in maintenance, replacement, labor and reagents.

The story of Wemco-Fagergren is one of success for the companies it has served. A Wemco representative can tell you how this "task force" of flotation can fit most profitably in your plans for the future.

WEMCO®

a division of

Western Machinery Company

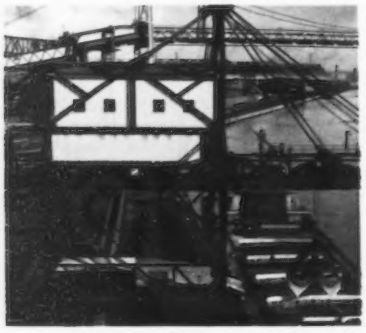
650 Fifth Street, San Francisco 7, California

and throughout the world

How Dravo serves the mining industry

MATERIALS HANDLING EQUIPMENT

Traveling unloader removes iron ore at the rate of 1600 tons per hour from Great Lakes ore boats at this dock on Chicago's Calumet river. Check the coupon at right for information on Dravo equipment for the fast handling of ore, coal and a great variety of dry bulk materials.



ORE PROCESSING

Over 45% of sinter capacity added by U.S. steel industry in last 5 years has been furnished by Dravo—including this 2400-ton-per-day plant. Check coupon for information on sintering, briquetting, pelletizing and ore beneficiating facilities at mine or plant site.

SPECIAL CONSTRUCTION

Head frame (left foreground of photo) sits astride 575-ft. concrete-lined ventilating shaft at an eastern coal mine. Construction of shafts, slopes, tunnels, docks and harbors are part of Dravo's half century of experience in special construction for the mining industry. Mail coupon at right for more information.

Dravo furnished ore handling and agglomeration facilities for this midwestern steel producer.

PLANT UTILITIES

When completed, this modern intake and pumping station will handle up to 30 million gallons of water daily. Such Dravo turn-key projects include oxygen, power and boiler plants, compressor stations, special mine, utility and plant facilities. Check coupon for information.

SPACE HEATING

One of 60 Dravo space heaters which supply comfort heating in this large strip mill. Over 20,000 (¼ to 3 million btu) are in use throughout industry for processing, manufacturing, warehousing and other structures. Check and mail coupon for details.

Dravo Corporation, 4754 Grand Avenue, Pittsburgh 25, Pa.

Please send me information on the following products and services

☐ Shafts, Tunnels	☐ Sinter Plants & Coolers
☐ Docks, Harbors	☐ Grating
☐ Briquetting	☐ Space Heaters
☐ Pelletizing	☐ Water Intakes
☐ Ore Beneficiation	☐ Fabricated Piping
☐ Ore & Coal Unloaders	☐ Towboats, Barges
☐ Ore Bridges	☐ Lubrication Systems

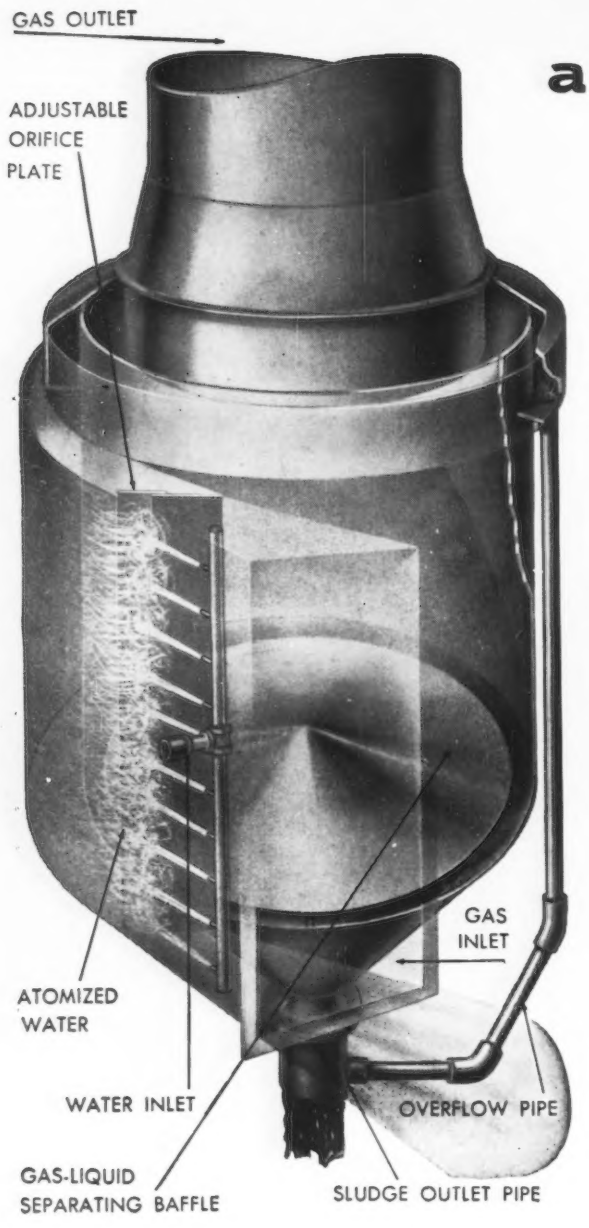
Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

DRAVO



a NEW scrubber for ultra-efficient dust and fume control

THE DUCON TYPE VO Oriclone® SCRUBBER

- **50% less space requirements than other high energy scrubbers.**
- **Higher operating efficiency at lower horsepower.**
- **Adjustable orifice maintains peak efficiency when operating conditions vary.**
- **Economical in first cost and operating cost.**
- **Simplicity of design permits economical alloy construction or acid brick lining.**
- **99% efficiency below 2 micron and in sub-micron range.**

The Ducon Type VO Oriclone Scrubber—the only high energy scrubber with an adjustable orifice—is the most effective and most economical dust and fume collector for a wide range of industrial applications, including recovery of catalyst dust, cupola dust and fumes, acid mists, tar fog and many others.

The Oriclone Scrubber is a completely integrated unit that performs the entire separation cycle. No subsequent collector is needed.

Send today for detailed information on Oriclone.

the name in DUst CONtrol

DUCON — DUST CONTROL SYSTEMS AND EQUIPMENT

Patent Pending

THE Ducon COMPANY INC.

147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

Canadian Branch:
THE DUCON COMPANY of CANADA, Ltd.,
1131 Pettit St., BURLINGTON, ONTARIO

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

Special report to users of Cat D6 and D7 track parts

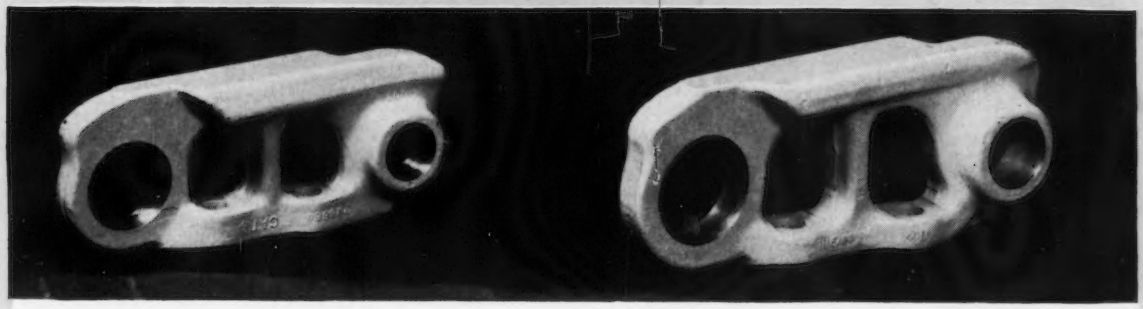
CAT CATERPILLAR

Parts you can trust
...cost less per hour

Up to 25% Longer Link Life at No Increase in Cost

New track links have rails hardened deeper than any other brand . . . hardness with file-like, wear-resistant qualities

You can't "see" metallurgy and heat treatment in track links. But you'll definitely see the *results* in the extra life you get from the *new* Cat D6 and D7 track links. These superior links will outlast all other brands yet the suggested price is no higher than before.



D6, 955 AND 561 LINKS

- "Hi-Electro" hardened rails give outstanding wear life.
- Rail wear cases are twice as deep as other brands.
- Closer bore tolerances retain pins and bushings better.
- Full 1¼" top rail surface to pin boss clearance allows more wear before roller flange contact.

D7, 977 AND 572 LINKS

- 12% thicker rails eliminate peening, rebuilding distortion.
- 32% thicker struts and more steel in critical areas increase over-all strength, resist cracking.
- File-hard "Hi-Electro" hardened rails withstand abrasive wear.
- Uniform, wear-resistant rail cases deeper than other makes.

These new track links are made from special steel, carefully pretested *before* manufacture. They're forged, machined and heat treated to develop maximum strength and toughness. A non-peenable wear barrier is induced *deeply* into rail top and sides by exclusive "Hi-Electro" hardening. This exacting heat treatment permits maximum, file-like wear resistance without brittleness.

Try the new links . . . and the many other *special-purpose* tractor undercarriage parts, all designed and built to keep your cost-per-hour to a minimum. Cat undercarriage specialists can help you select right combinations and give you money-saving recommendations tailored to your particular needs. It's all a part of your Dealer's Custom Track Service . . . the practical approach to lowering undercarriage costs by extending part life and machine availability through proper parts selection and parts care.

Etched rail cross-section shows deep, uniform wear case found on top and sides of new links.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Caterpillar Tractor Co.; General Offices,
Peoria, Illinois, U. S. A.

As the Dolomite Company knows so well . . . hauling profits depend on the

RIGHT TRUCK ON EVERY JOB

Dolomite Products Co., Inc., Rochester, N. Y., avoids profit-squeezing hauling costs because it has the know-how and experience to analyze its truck needs with an eye to keeping costs under strict control. Loads, terrain, schedules, climate, speeds, etc., all must be carefully weighed in selecting trucks for best all-round performance. For twenty years, Dolomite has been developing the use of Mack trucks in a wide variety of assignments . . . keeping its large and diversified operation rolling smoothly, profitably.

In the quarrying phase of Dolomite's operation, for example, Mack B-813 Models, hauling double-bottom side-dumpers, team up with fast shovels to deliver four to five thousand tons of dolomite rock to the crusher each shift.

Modern efficient high-volume operations like those of Dolomite depend on modern efficient equipment to keep operating costs low. Macks, like the B-813's used in this quarry operation, contribute to high efficiency because of their outstanding performance characteristics. The Mack Turbocharged Thermodyne® engines provide plenty of power for fast get-aways under full loads. Massive self-equalizing brakes and easy, positive power steering assure safe, fast maneuverability at shovel and crusher. Traditional

UNDER THE SHOVEL—Fast cycle time with big loads is needed in quarry work. Dolomite puts big Mack double-bottom side dumpers on this assignment.

AT THE CRUSHER—Turbocharged Thermodyne diesel-powered Mack side-dumper empties quickly at the crusher as another big load pulls into position behind it. These units operate on only 20 gal. of fuel per 9 hr. shift.

FOR STOCKPILING—Crushed stone rolls to stockpile on Mack B-42T combinations. Manitou Construction Co., a division of Dolomite Products Co., Inc., also uses these vehicles to handle material for paving jobs.

Mack construction throughout reduces down-time and maintenance.

These are sound reasons why Macks are first choice where profitable operations rely on truck performance . . . why a Mack will pay for itself again and again by delivering top work capability per dollar invested. Your Mack representative is qualified by knowledge and experience to help you determine the Mack model that will provide the most economical solution to your trucking problem. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

8156

MACK
FIRST NAME FOR
TRUCKS

MACK
for over 8 straight years
NO. 1
by far in sales of diesel trucks

Shock-Fortified Firestones

KEEP QUARRY LOADS HUSTLING

Between multi-ton loads and rubble-strewn haulroads, it takes tough tires to keep quarry operations moving. That's why you need the extra stamina built into the Firestone Rock Grip Deep Tread. Firestone Rubber-X, the longest-wearing rubber ever used in Firestones, is specially compounded to resist rock and shale cuts. And Firestone's Shock-Fortified nylon cord takes jarring body blows in stride. Match Firestones to all your hard-running equipment. They're backed by swift, on-the-spot service. See your Firestone Dealer or Store.

Always Specify Firestone Tires When Ordering New Equipment.

Firestone

FIRST IN OFF-THE-HIGHWAY TIRE NEEDS

Copyright 1961, The Firestone Tire & Rubber Company

This mark tells you a product is made of modern, dependable Steel.

It doesn't take long to deliver quality USS Grinding Balls!

No delivery problems. We don't actually catapult USS Grinding Balls—we're afraid it wouldn't make a hit with our customers. But we always ship them immediately—all the balls you need, exactly when you need them.

No selection problems. You can order from a complete stock of USS Carbon-Manganese and USS Alloy Steel Balls, in a range of sizes from ¾" to 4".

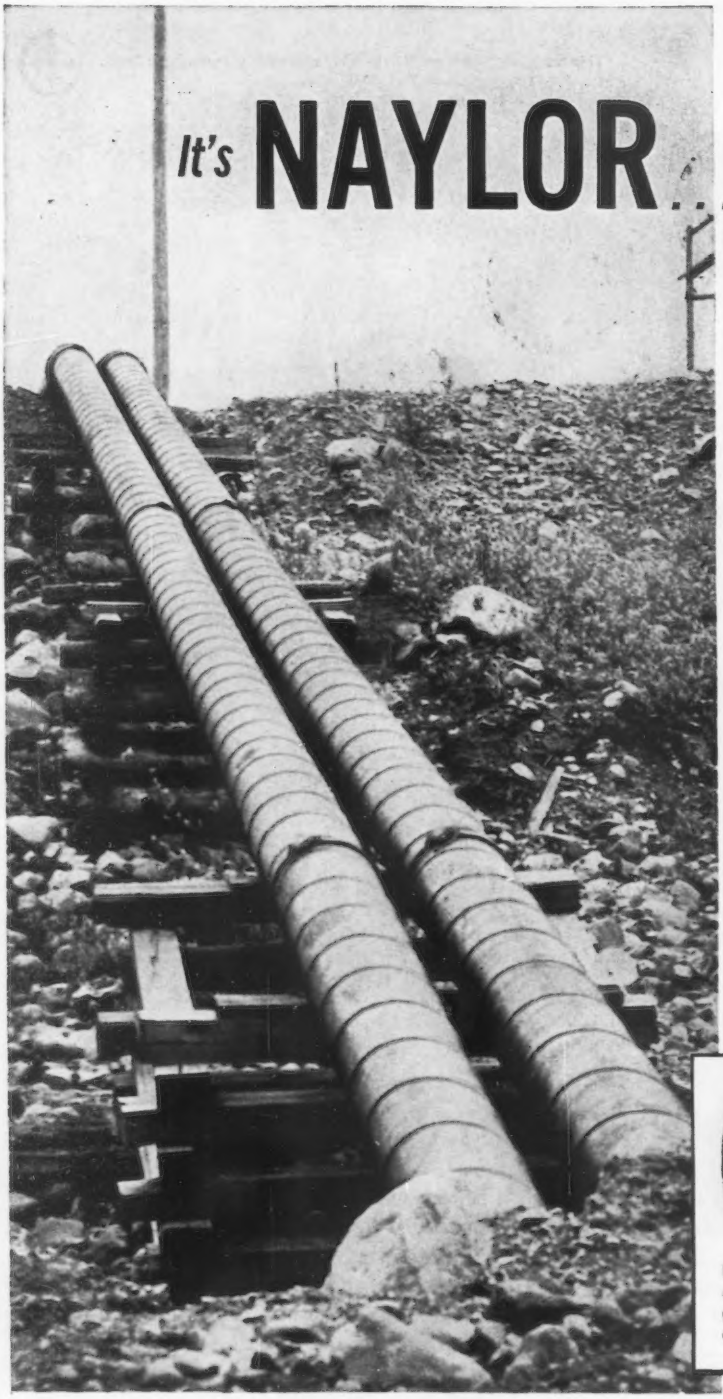
No performance problems. USS Grinding Balls are hard, tough, and uniform. Hardness surveys under direction and control of USS Research Center proved that maximum depth of hardness consistent with toughness is provided by our product in both carbon and alloy grades in all sizes. You cannot buy a better ball for your purpose!

Call our nearest Sales Office or United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal & Iron Division • United States Steel Export Company

USS United States Steel

TRADEMARK



It's NAYLOR... the Pipe and Coupling Combination for Savings!

You can't match the combination of NAYLOR Spiralweld pipe and Wedgelock couplings for saving time, work and money on pipe lines in mining service.

Your savings start with the light weight of the pipe, but there's no sacrifice of strength, thanks to the exclusive lockseamed-spiralwelded structure. Handling is simplified, installation is faster and easier, especially when you use NAYLOR Wedgelock couplings to speed connections.

For air, water, and tailings service, get the details on this NAYLOR time-and-money-saving combination. Ask for Bulletin No. 59.

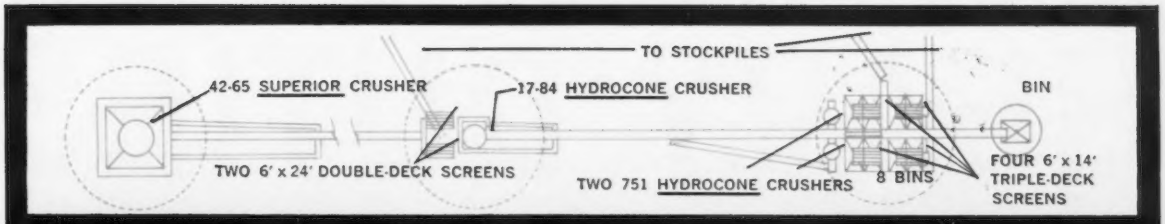
NAYLOR Wedgelock couplings make a positive connection securely anchored in standard weight grooved ends. A hammer is the only tool required to connect or disconnect the coupling.

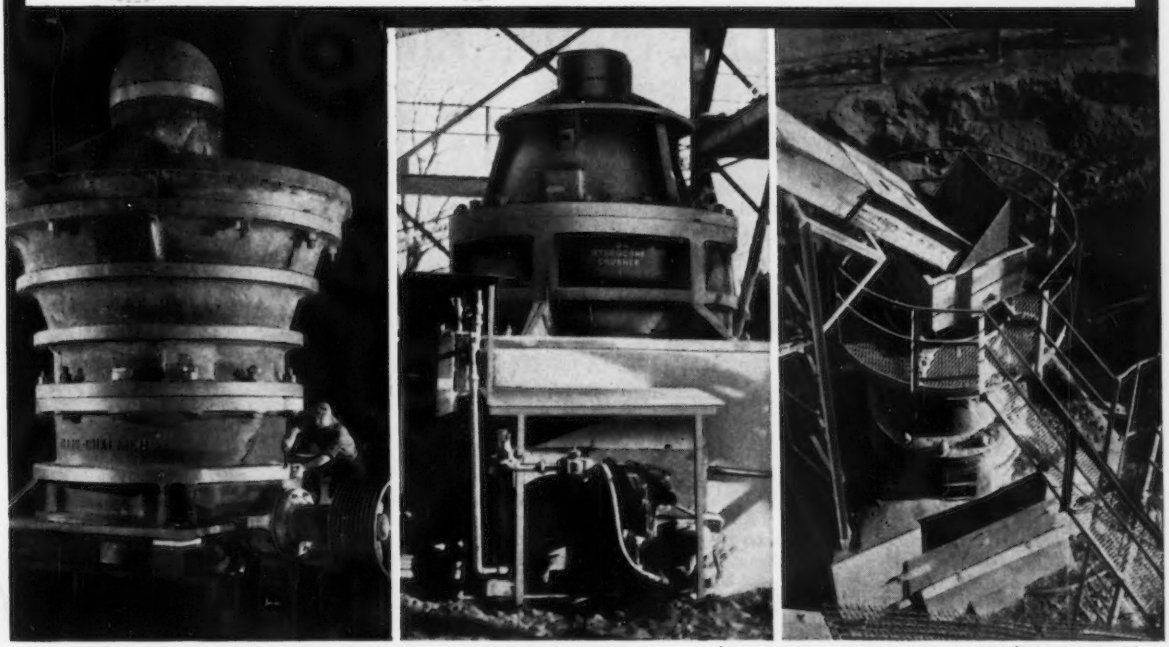
NAYLOR PIPE Company

1243 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

ALLIS-CHALMERS





Superior, Hydrocone and Hydroset are Allis-Chalmers trademarks.

Rugged Hydroset control sets a fast pace for crushers:

900,000 tons in 4½ months!

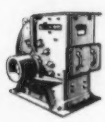
Crushing trap-rock is a tough assignment. A tight time schedule makes it even tougher for Chantilly Crushed Stone Company. They were awarded the contract for all of the crushed stone — base course and concrete specification stone — for the new $75,000,000 John Foster Dulles Airport just outside Washington, D. C.

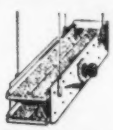
To meet production requirements, they had to have crushers that were rugged and dependable. Crushers that would provide rapid compensation for the wear that always accompanies the crushing of trap-rock. Crushers that would *not* require extensive downtime to unload in the event of power failure.

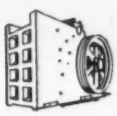
To get the job done, Chantilly built their plant around four Allis-Chalmers crushers: a 42-65 *Superior* gyratory for primary crushing, a 17-84 *Hydrocone* crusher for secondary crushing, and two 751 *Hydrocone* crushers for tertiary crushing. All four crushers were equipped with *Hydroset* control.

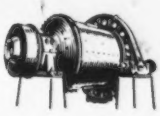
It was *Hydroset* control that made compensations for wear in minutes, not hours... made the quick changes in product size from base course to concrete specs.

Ask your A-C representative about the rugged flexibility of A-C crushers equipped with Hydroset control. Or write **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1336


Hammer Mill


Vibrating Screen


Jaw Crusher


Grinding Mill

Kiln

The newest reason to make your next tandem a FORD:

'61 FORD HEAVY DUTIES

GIVE TWICE THE CAB, FENDER AND RADIATOR LIFE!

Rugged Ford Heavy Duties utilize heavier gauge steel, sturdier reinforcements, and a new independent mounting system to separate cab, fenders and radiator. This stronger construction, with each component *individually* frame-supported, doubles cab, fender and radiator life—cuts downtime delays and maintenance expense.

CAB—A 25% heavier floor pan and toeboard provide a solid base for greater cab durability. New full-length door pillar reinforcements and stronger inner door panels minimize door sag. New triangular mounts keep cab level and protect it from frame-movement stresses.

FENDERS—Ford fenders are 25% heavier gauge, too. They are bolted to a rubber-cushioned transverse support in front for needed flexibility. Fender-wide rear brackets provide necessary rigidity. The removal of only 9 bolts permits pulling the fender assembly for easier access to engine.

RADIATOR—New Ford "lock-seam" construction doubles the solder area on key seams, and heavier gauge tank and header walls provide increased radiator strength. "Horse collar" mounting on rubber pads soaks up vibrations and diagonal braces at sides give solid support.

Ford's separate mounting of cab, fenders and radiator frees them from frame-movement stresses that occur when these parts are rigidly attached to each other. Result: failures and service costs are reduced even in tough off-road operation.

Ford T-Series tandem rear axle trucks and tractors are available with GVW's up to 51,000 lb.—GCW's up to 75,000 lb. Your choice of Timken or Eaton axles with up to 38,000 lb. tandem capacity. Seven exclusive-truck V-8 engines range from 302 to 534 cubic inch displacement.

SEVEN MORE REASONS WHY IT'S GOOD BUSINESS TO DO BUSINESS WITH FORD!

You save from the start with Ford's traditionally low prices, and your savings continue with low operating and maintenance costs. These facts are documented by certified test reports from America's foremost independent automotive research firm. Ask to see these reports. They're on file at your Ford Dealer's.

In addition to these dollar-and-cents savings, the following bonus benefits are yours with Ford Trucks:

1. **Rigid quality controls** give you the strongest safeguard of truck reliability ever. Modern, *exclusive-truck* manufacturing facilities, with emphasis on quality every step of the way, are designed to give you a Ford Truck that is as free from defects as a truck can be. Tangible results of these high standards are Ford's new warranties.

2. **Exclusive 100,000-mile warranty** (or 24 months) on 401-, 477- and 534-cu. in. Super Duty V-8's is the most liberal in the industry. Each major engine part (including block, heads, crankshaft, valves, pistons, rings), when engine is used in normal service, is warranted by your dealer against defects in material or workmanship for 100,000 miles or 24 months, whichever comes first. The warranty covers full cost of replacement parts . . . full labor costs for first year or 50,000 miles, sliding percentage scale thereafter.

3. **12,000-mile warranty** (or 12 months) on all 1961 Ford Trucks of every size is further evidence of the confidence Ford has in its quality controls. Each part, except tires and tubes, is now warranted by your dealer against defects in material or workmanship for 12 months or 12,000 miles, whichever comes first. The warranty does not apply, of course, to normal maintenance service or to the replacement in normal maintenance of parts such as filters, spark plugs and ignition points.

4. **Special fleet financing** can be arranged by your Ford Dealer. It's available for owners of two or more trucks, and provides the opportunity to precisely tailor payments to your income patterns or depreciation schedules. This fleet-fitted financing offers substantial savings and frees your working capital.

5. **Sales engineers and service specialists** in 36 district offices are on call to solve special truck problems. Working with both dealers and customers, these experienced truck men represent another extra step Ford takes to provide your continued satisfaction.

6. **Replacement parts depots** at 26 strategic locations across the country quickly supply needed parts from ample stocks. Ford's entire supply system is geared to give you faster service and reduce costly downtime . . . *wherever* you are.

7. **6,800 Ford Dealers,** including 280 specialized Heavy Duty truck dealers, can keep your trucks ready to go wherever they go. From coast to coast, fast Ford service—gas *and* Diesel—is always close at hand.

From Super Economy pickups to Diesel-powered tractors, you can now fill every truck need up to 76,800 pounds GCW with a modern, money-saving Ford Truck.

Quality-Built...Maintenance-Engineered

FORD TRUCKS COST LESS

FORD DIVISION, Ford Motor Company

Proof from Jones & Laughlin!

Ni-Hard liners keep their contour after grinding better than 2 million tons of ore

Here's photographic proof from the Benson Mine, New York Ore Division of Jones & Laughlin Steel Corporation in upstate New York.

Ni-Hard liners keep their contour — resist abrasion — provide a slow, uniform wear rate — are good to the last ¼ inch.

You could never tell by looking at them, but these Ni-Hard* nickel-chromium-iron alloy shell liners have been grinding iron ore *for more than 2 years.* With better than 2 million tons of ore behind them, they've still got plenty of tonnage left in them!

Used in J&L's ball mills and rod mills —at the feed end as well as the discharge end—these Ni-Hard liners are delivering *superior abrasion and wear resistance.* They're saving many thousands of hours of downtime, many thousands of dollars in repair and replacement.

Try a set of Ni-Hard liners and see for yourself how the abrasion and wear resistance of Ni-Hard can increase *your* tonnage, can lower *your* costs.

Our detailed 58-page booklet, "Engineering Properties and Applications of Ni-Hard" suggests many ways to put this versatile and long-lasting material to work profitably. Say the word and we'll be glad to send you a copy.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

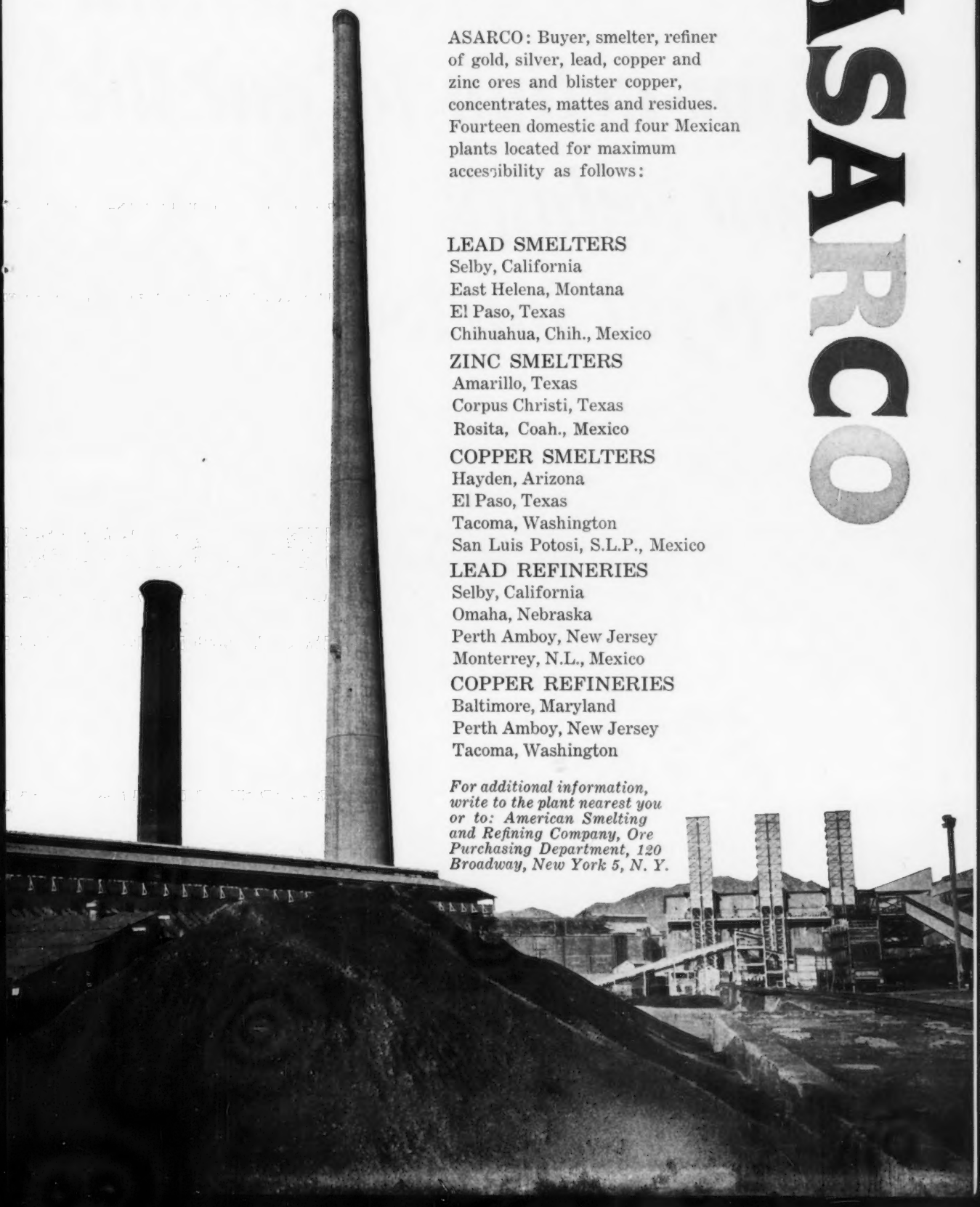
NI-HARD®

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

For carloads or small lots

Eighteen convenient smelters and refineries

ASARCO



ASARCO: Buyer, smelter, refiner of gold, silver, lead, copper and zinc ores and blister copper, concentrates, mattes and residues. Fourteen domestic and four Mexican plants located for maximum accessibility as follows:

LEAD SMELTERS
Selby, California
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El Paso, Texas
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ZINC SMELTERS
Amarillo, Texas
Corpus Christi, Texas
Rosita, Coah., Mexico

COPPER SMELTERS
Hayden, Arizona
El Paso, Texas
Tacoma, Washington
San Luis Potosi, S.L.P., Mexico

LEAD REFINERIES
Selby, California
Omaha, Nebraska
Perth Amboy, New Jersey
Monterrey, N.L., Mexico

COPPER REFINERIES
Baltimore, Maryland
Perth Amboy, New Jersey
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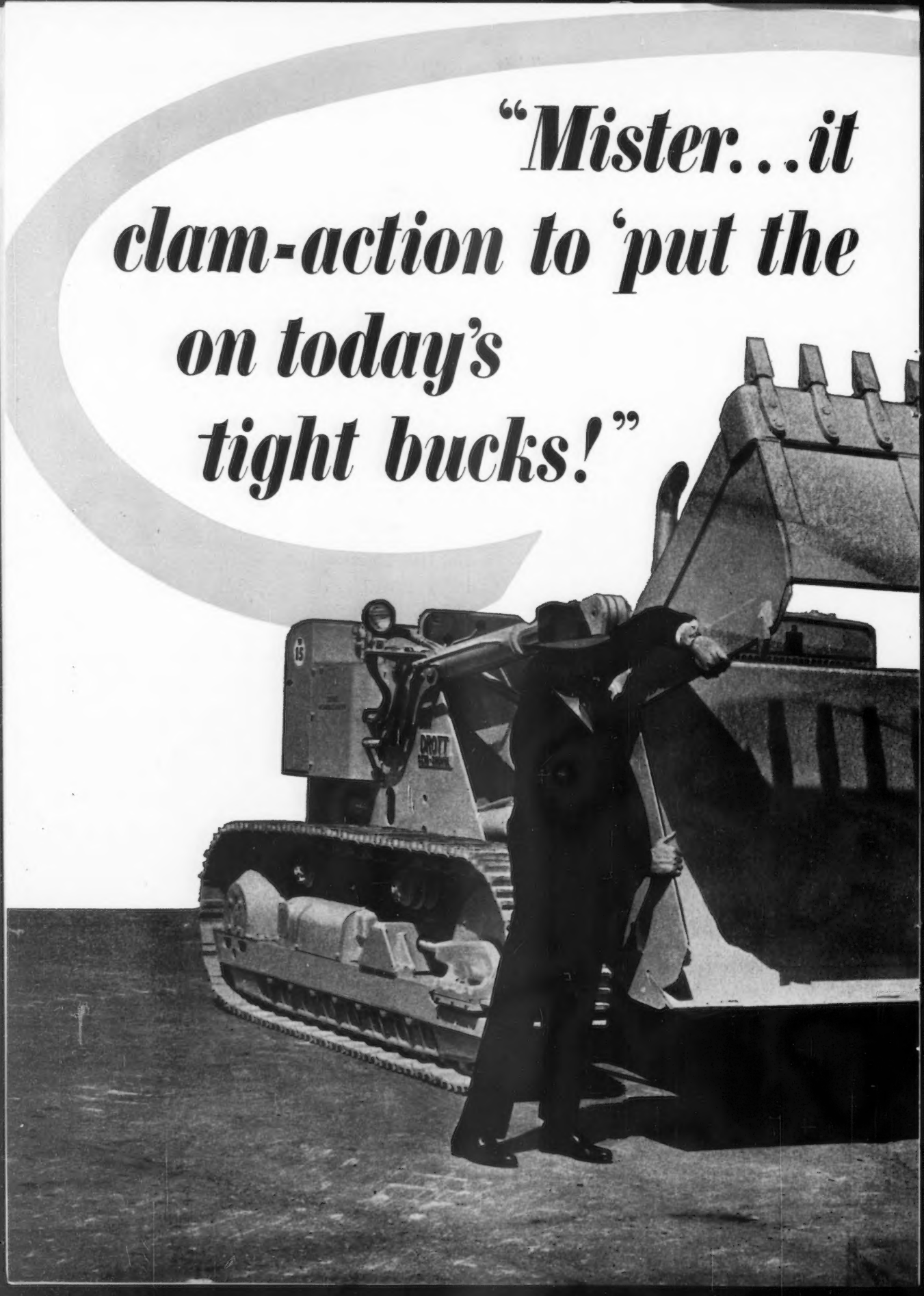
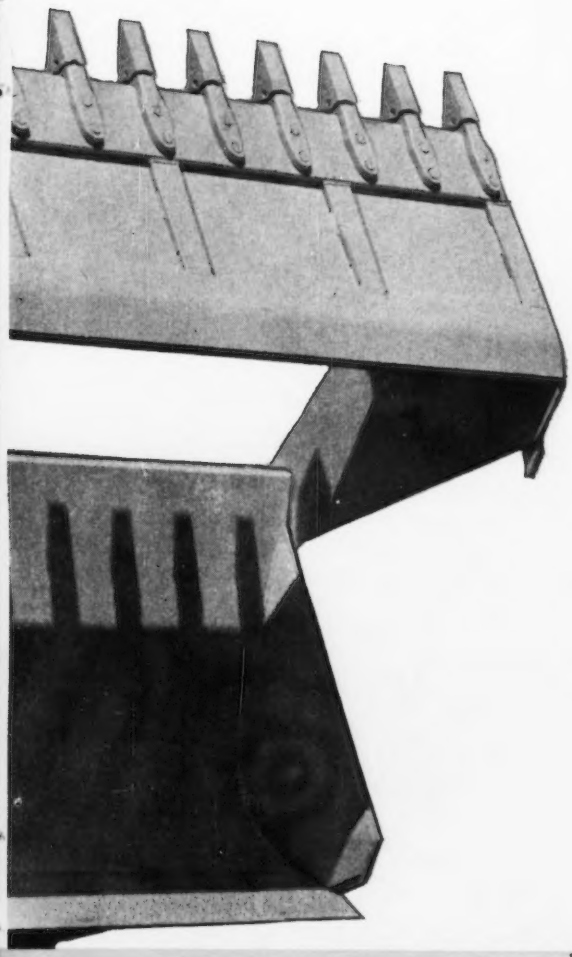
For additional information, write to the plant nearest you or to: American Smelting and Refining Company, Ore Purchasing Department, 120 Broadway, New York 5, N. Y.

"Mister...it clam-action to 'put the on today's tight bucks!"



takes bite'



"15 minutes on this new '15' Four-in-One will prove you can't afford to own any limited-duty bucket!"

"Sure, a racehorse loader with a 'lock-jawed' bucket may gain you a few minutes a day—just dipping from a stockpile and dumping in a truck!

"But anywhere else we double-challenge you to stack any limited-duty loader against a new '15' clam-action 4-in-1, and see what happens. We can tell you right now what'll happen no matter what size, shape or color the single-action rig is, or how shifty it is! It'll get clobbered! And, profitwise, so will the guy who buys the obsolete bucket without bothering to find out what a slew of jobs the new '15' Four-in-One does.

"You can get the straight dope, first hand in 15 minutes, on this new TD-15 Four-in-One. In just one quarter-hour, you can prove what it means to own the one and only machine that doubles for a whole spread of contracting equipment—at the touch of a hydraulic lever.

"In only 15 minutes, you can put the 'bucket with the bite' through its paces. Prove how you get four, or a dozen, or more, full-sized, full-capacity machine actions with the exclusive 4-in-1. Prove you get hundreds of job-handling working positions with each action.

"See how new TD-15 Four-in-One get-up-and-go is tailored to set a fast work pace, with the single-stick shift, full-reverse transmission, and plenty of hydraulic control power.

"C'mon in now—take 15 minutes on a new '15' Four-in-One. Or call us for a demonstration on your job. See for yourself why you can't afford to own any obsolete 'lock-jawed' loader."

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL HARVESTER

INTERNATIONAL®
DROTT®

"'Doze, grade, grab, spread, do cut-and-fill work, strip, load sticky materials, outshovel a power shovel, pick up loose materials (without chasing them), grub, load 'impossibles.' Do dozens of other profitable jobs with the new '15' Four-in-One that single-action loaders can't touch."

Take 15 minutes on a

Prove New International TD-15 cost-cutting capacity tops the 100 hp class

Advantages in heavy-duty hp and in working speeds give the new TD-15 extra work capacity to cut costs, boost earnings — as compared to competitive rigs. *You can prove it, positively.* Advances in strength, wear-resistance, temperature control, and operating ease mean big gains in component life, upkeep economy and machine availability to owners of new International TD-15's. *You can prove it, beyond doubt, without risk.* Let your International Construction Equipment Distributor give you the revealing 15-minute new "15" demonstration, now!

Prove new TD-15 capacity dozing heavy materials

Fast, easy new TD-15 shifting saves effort, increases output. Size up the new "15's six-speed, full-reverse transmission with speeds spaced to use extra power and often work a *speed faster* than competitive rigs. See how the six speeds forward, six reverse, are arranged for easy short-travel, single-stick shifting. Change forward-reverse direction fast with the "Shuttle-Bar." Check the power-transfer efficiency and operating ease of the new "15's heat-defying, dry-type sintered metal engine clutch!

Give the new "15" a steady job of bulldozing solid materials! Advances like tapered, anti-friction bearings of greatly increased capacity — heavier shafts and deeper, stronger gear teeth — add thousands of hours to transmission component life. New transmission oil pump circulates and filters lubricant for longer gear life. Measure the added economy of features like the new sintered metal steering clutch discs which outlast previous type even while handling greater torque loads!

International® *Construction Equipment*

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.
A COMPLETE POWER PACKAGE

New "15" (151 SERIES)

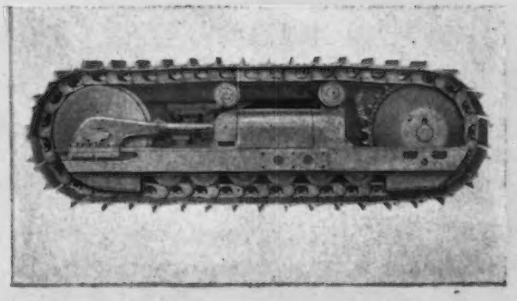
Compare hp and performance protection!

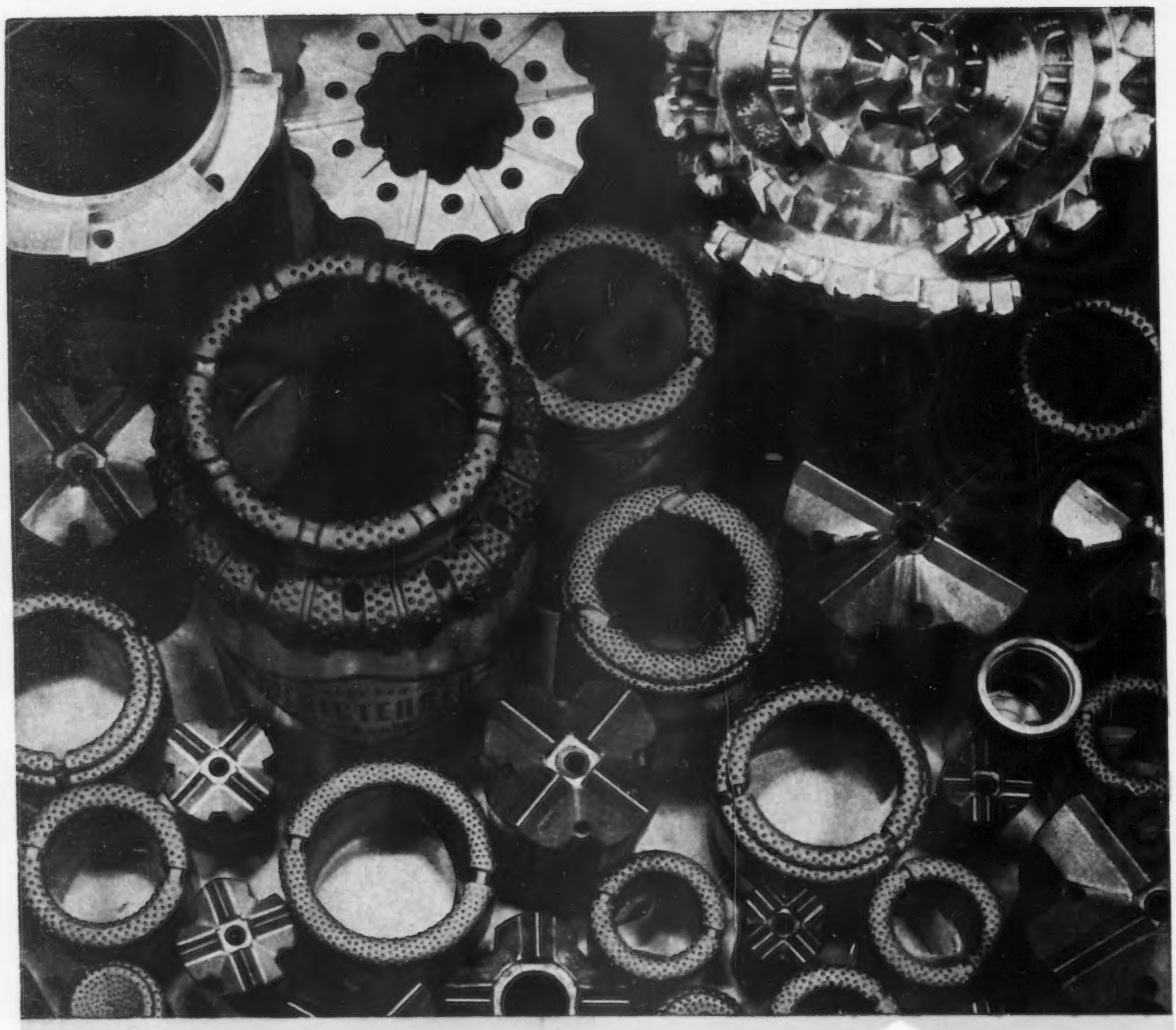
Start the new TD-15's 6-cylinder engine push-button easy — and get the seconds-fast warm-up which only International's famous gasoline-conversion starting provides. Note that *full load* for the new "15" is an overload for other rigs of the 100-hp class. See how the new pressure-type cooling teams with the larger capacity radiator — to give positive temperature control in hottest weather at full capacity 'round the clock.

Look at the "15's" new dry-type air cleaner. It's 99.8% efficient — and 100% convenient! Handy, underhood mounting and transparent, quick-dump collector greatly simplify servicing. International even provides a dash indicator that shows red when element needs servicing!

Prove new "15's" undercarriage strength!

To go along with precision-welded double-box-beam TD-15 track frames is the added strength of drum-type front idlers — the added protection of frame-welded track chain guides — the added service life of self-cleaning, power-saving strutless track links. The new "15" is the only crawler of its power class with the shock-load prevention of ball-joint suspension — basic in International's famous 3-point track mounting design! Improved, high-efficiency full-floating seals protect the long life Dura-Rollers — the track rollers you grease *only once* per hundred 10-hr. shifts!





If your problem is making hole . . .

. . . Christensen offers a complete line of diamond bits, reaming shells, and core barrels. Also available are tungsten carbide and roller cone bits. When you need "complete" custom bit service, contact Christensen.

"Less cost per foot"

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MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST
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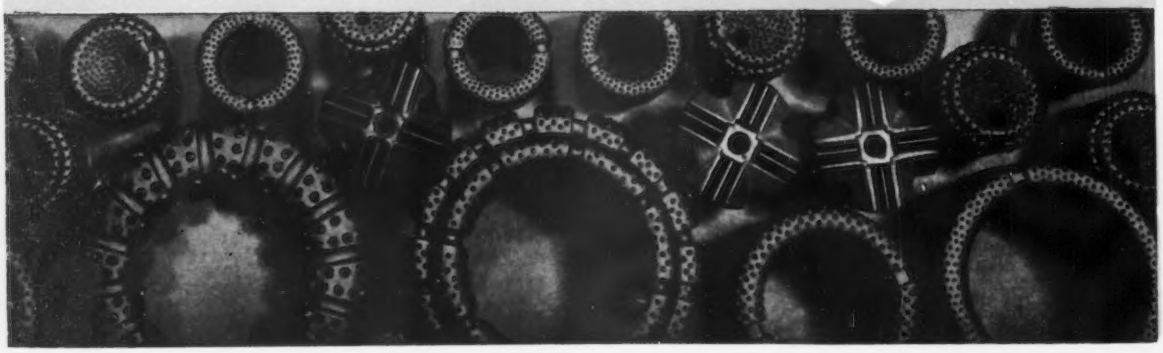
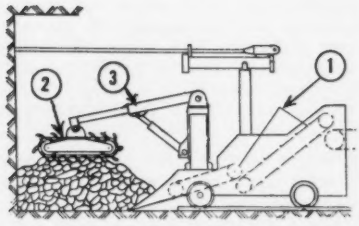
SERVICE FROM WORLD-WIDE SALES OFFICES AND MANUFACTURING PLANTS



NEW PATENTS

Tomorrow's technology

OLIVER S. NORTH



LOADER FOR REMOVING broken material from tunnel faces. The loader consists of an intermediate loader (1) and a continuously running scraper belt (2) attached to a telescoping and swiveling jib or beam (3). Distance between the scraper belt and intermediate loader unit can be changed by simply extending or retracting the boom holding the scraper belt assembly. Material scraped onto the intermediate loader by the belt is transferred by belts either to cars or to main conveyor leading to loading station in drift or tunnel. German patent DAS 1090161, submitted June 18, 1955; issued October 10, 1960 (Kl. 5d, Gr. 12.) Inventor and submitter: Dipl.-Ing. W. Kamm, Bochum. Abstracted from Erzmetall.

U. S. PATENTS

Metal & Mineral Processing

Recovery of tellurium from copper anode slimes. A mixture of slimes and sodium carbonate is roasted and water leached, and the undissolved residue treated with sulphuric acid. The tellurium-enriched acidic liquor is treated with metallic copper, and the resulting cementation product smelted with a soda flux. Tellurium is drawn from the upper slag layer. S. B. Tuwiner, assigned to Phelps Dodge Corp. U.S. 2,981,595.

Recovery of selenium from copper anode slimes. A high-solids mixture of slimes and sodium carbonate is extruded, and the extrusion coiled to form a bed. This bed is dried, roasted in an oxidizing gas, and leached with water. Leach liquor is neutralized, purified, and treated with sodium metabisulphite to precipitate elemental selenium. S. B. Tuwiner, assigned to Phelps Dodge Corp. U.S. 2,981,603.

Design for a gyratory ball mill for efficiently crushing ores, e.g. quartz ores. The ball load is confined in a gyratory shell in which the ball load depth, shell depth and diameter, direction of feed, and radius of gyration are so regulated as to take advantage of optimum crushing relationships. A. W. Fahrenwald. U.S. 2,982,485.

Process and apparatus for cooling the grates of iron ore sintering machines. The grate bars are cooled by contact with hollow, interiorly-cooled transverse members of the grate carriage. K. Meyer, O. Jenne, J. Schwalb, K. Michel, W. Stieger and F. Weng, assigned to Metallgesellschaft A. G. U.S. 2,982,533.

Continuous digesting of titaniferous iron ores or slags utilizing concentrated sulphuric acid and a foaming agent. T. S. Griffin, assigned to National Lead Co. U.S. 2,982,613.

Vertical apparatus for contacting iron ore pellets, sinter fines, or like materials with low velocity cooling air, whereby the dust problem is substantially eliminated. W. Zimmermann and J. Roder, assigned to Dravo Corp. U.S. 2,983,051.

Wet separating table for concentrating mineral values continuously at high capacity and with improved efficiency. The table surface contains a series of ribs with adjustable openings between, to which the mineral mixture is directed. Heavy particles pass through these openings to a collecting tray, while lighter material passes over a blade to the following ribbed surface. I. D. Russell, assigned to Denver Machinery Co. (Prop.) Ltd. U.S. 2,983,382.

Copies of U.S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D.C.

In the froth flotation separation of mixed ores, such as lead-zinc, iron-bearing lead-zinc, copper-zinc, copper-iron, copper-lead-zinc, an alpha hydroxynitrile is added to the mineral pulp as an iron depressant. Crude, unpurified lactonitrile is an economical and satisfactory material. E. L. Carpenter and R. B. Booth, assigned to American Cyanamid Co. U.S. 2,984,354.

In the direct production of lead metal from sphalerite ores or concentrates, the ore is melted without roasting, and the resulting molten lead sulphide bath blown in one spot with an oxygen-containing gas to produce an incandescent area. After about 30 min of blowing, the slag is tapped off and the moltenlead then drawn off. E. J. Kohlmeyer, assigned to Metallgesellschaft A. G. U.S. 2,984,562.

An improved balling drum for producing iron ore pellets from wet or sticky materials, whereby the pellets can be formed into porous beds suitable for high speed sintering into a coherent agglomerated cake. W. B. Thomas, G. L. Cox, Jr., and L. G. Tucker, Jr., assigned to Koppers Co., Inc. U.S. 2,984,860-1.

CANADIAN PATENTS

Metal & Mineral Processing

An improved centrifugal apparatus for concentrating mineral values from mixtures of gangue and values, e.g. Mesabi iron ores, Anaconda Manganese ore, lead-zinc ores, etc. Sharp separation is obtained by preventing mixing of the particles carried in the inner and outer vortices. V. Rakowsky. Apr. 18, 1961. Canadian 618,372.

Copies of Canadian patents can be obtained by writing to Commissioner of Patents, Patent & Copyright Office, No. 8 Bldg., Carling Ave., Ottawa.

Production of microscopically porous, hard, slag bonded, indurated iron ore pellets from ore concentrates. The moist ore is admixed with an optimum amount of dolomite or limestone, the mixture rolled into balls at ambient temperature, and the balls indurated at 2000-2400° F. to calcine the added flux and to initiate slag forming reactions between acidic and basic components of the pellets. F. D. DeVaney, assigned to P. M. Associates. Apr. 18, 1961. Canadian 618,-640.

Recovery of nickel, copper, cobalt, zinc, or manganese from oxide ores (including siliceous ores containing iron) and particularly from limonitic laterite ores. The ore is leached with an aqueous solution of sulphuric acid at elevated temperature and pressure, whereby nickel and other non-iron values are solubilized, and the solution then separated from the iron and silica solids. C. S. Simons, M. F. Dufour and E. T. Carlson, assigned to Freeport Sulphur Co. Apr. 25, 1961. Canadian 618,826.

Recovery of a purified sodium chloride product from impure natural rock salt, high-quality calcium fluoride from fluorspar ores containing impurities, sylvite from sylvinite ores, and like crystalline minerals from associated gangue. The Crushed material is exposed to radiant heat and then passed over a belt coated with a heat-softenable adhesive to selectively separate the components on the basis of the amount of heat absorbed. R. J. Brison, assigned to International Salt Co. Apr. 25, 1961. Canadian 619,-003.

E&MJ Monitor

Method for reducing the processing time in the reduction of iron ore in an electric arc furnace, A thick bed of granular or powdered coal is built up in the furnace pit, and graphite electrodes are suspended near the periphery of the coal bed. As current is applied the bed is rendered semi-fluid, and iron ore fines are fed onto and through the fluidized coal bed. W. Wenzel. Apr. 25, 1961. Canadian 618,784.

Mr. North is patent consultant, Washington, D.C.

NEW BOOKS

Keeping up with your profession

Cobalt: Chemistry, Metallurgy and Uses, ACS Monograph 149, edited by Roland S. Young. This book contains the latest information on the production and consumption of cobalt in all its forms. Leading authorities in the field discuss the occurrence, extractive metallurgy, properties and compounds of cobalt. Published by Reinhold Publishing Corp., Dept. J, 430 Park Ave., New York 22, N.Y. 424 pp. Price $15.00.

The Mineral Wealth of Wales and Its Exploitation, by Trevor M. Thomas. In this comprehensive survey, Mr. Thomas, who has specialized in the study of mineral resources in relation to land-use planning, deals with the distribution, extent, mode of occurrence and economics of all known mineral resources in Wales. Published by Oliver and Boyd Ltd., Edinburgh, Scotland. 248 pp. Price 30s.

A History of Platinum, by Donald McDonald. This historical work covers the development of platinum from the earliest known times to the 1880's. Published by Johnson Matthey & Co. Ltd., Hatton Garden, London EC 1. 254 pp.

List of Publications, State of Tennessee, Department of Conservation and Commerce, Division of Geology. This handy booklet lists all publications of the Division, including obtainability and price. Available from the Tennessee Division of Geology, G-5 State Office Bldg., Nashville 3, Tenn. 26 pp.

Annual Report of the Director of the Geophysical Laboratory, reprinted from the Carnegie Institution of Washington Year Book 59, for the year July 1, 1959-June 30, 1960. This booklet covers research work conducted by the Institution, including articles on the synthesis of diamonds, the physical properties of various mineral systems, and age determinations of rocks. Published by the Carnegie Institution of Washington, 2801 Upton St., Northwest, Washington 8, D.C. 187 pp.

E&MJ Monitor

Geology and Mineral Resources of Rockingham County, Bulletin 76, by William B. Brent. Published by the Virginia Division of Mineral Resources, Charlottesville, Va. 174 pp plus maps.

Dictionary of Mechanical Engineering, by Alfred Del Vecchio. This dictionary gives definitions in the fields of architecture, automatic controls, engineering mechanics, fuels and combustion and power plants, along with related definitions in the fields of basic electricity, heat treatment of metals, basic mathematics, and welding. Published by Philosophical Library Inc., 15 E. 40 St., New York 16, N.Y. 346 pp. Price $6.00.

Potash Deposits, Rock Salt, and Brines in Manitoba, Publication 59-1, by Barry B. Bannatyne. Published by Department of Mines and Natural Resources, Province of Manitoba, Winnipeg, Manitoba. 30 pp.

Barometer Rising 1960, Review of the Ontario Department of Mines. The report deals with all producing mines in the province, and presents a compact summary of conditions in the various sectors of the mining industry. Single copies without charge are available from the Publications Office, Department of Mines, Province of Ontario, Toronto, Ont. 120 pp.

Northern Rhodesia Chamber of Mines Year Book 1959. This book presents a statistical summary of mining activities. Available from the Northern Rhodesia Chamber of Mines, P. O. Box 134, Kitwe, Northern Rhodesia. 88 pp.

Outdoor Recreation and Its Relation to the Mining Industry. This booklet explains how the mining industry has made possible the development of many of our outdoor recreational areas. Published by American Mining Congress, Ring Building, Washington 6, D.C. 16 pp.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

Gmelin Handbuch der Anorganischen Chemie, 8. Auflage. The following volumes of this extensive reference work on the various minerals have been recently published by Verlag Chemie, CmbH., Weinheim/Bergstr. (West Germany) and are available in the U. S. from Walter J. Johnson Inc., 111 Fifth Ave., New York 3, N.Y. and Stechert-Hafner Inc., 31 E. 10 St., New York 3, N.Y.:

Lithium, Supplement Volume, German-English table of contents, headings and sub-headings in English on the margins of the text. This book covers the occurrence preparation, isotope separation, physical properties, electrochemical behavior, chemical reactions, alloys, and compounds of lithium. 525 pp, 73 graphs. Price in wrappers $77.50, cloth bound $78.50.

Mercury, Section 1. German-English table of contents, headings and sub-headings in English on the margins of the text. Subjects covered are the history of mercury up to about 1800, occurrence, production statistics, uses, toxicity, formation and preparation, manufacture, preparation of special forms and physical properties. 466 pp, 53 graphs. Price in wrappers $67.50.

Sulphur, Part B, Section 2. German-English table of contents and English headings and sub-headings on the margins of the text. This sections covers the description of the sulphur-oxygen acids with a section on the SO_2-H_2O system. 758 pp, 146 graphs. Price in wrappers $111.00, cloth bound, $112.00.

Geologic Reconnaissance of the Northern Coast Ranges and Klamath Mountains, California, Bulletin 179, by William P. Irwin. Published by the California Division of Mines, Ferry Bldg., San Francisco, Calif. 80 pp plus maps. Price $3.00.

Mississippian Horton Group of Type Windsor-Horton District, Nova Scotia, by W. A. Bell. Published by the Geological Survey of Canada, Department of Mines and Technical Surveys, Ottawa, Canada. 112 pp. Price $2.

The Geology and Mineral Resources of the Kinta Valley, Perak, Federation of Malaya Geological Survey, District Memoir 9, by F. T. Ingham and E. F. Bradford. This book describes the general and economic geology of the Kinta Valley, which, since 1800, has been the world's leading tin producer. Also included are brief descriptions of the various mines and an extensive list of references, including a list of publications of the Geological Survey. Published by Geological Survey Headquarters, P. O. Box 1015, Ipoh, Federation of Malaya. 347 pp. plus maps. Price $10 (Malayan).

The following publications are available from the Montana Bureau of Mines and Geology, Montana School of Mines, Butte, Mont.:

Preliminary Report on the Geology and Ground-Water Resources of Northern Blaine County, Montana, by Everett A. Zimmerman. 19 pp plus map.

Biennial Report of the Montana Bureau of Mines and Geology to the Legislative Assembly for the reporting period July 1, 1958 to June 30, 1960, Edwin G. Koch, Director. 155 pp plus map.

Pre-Beltian Geology of the Cherry Creek and Ruby Mountains Areas, Southwestern Montana by E. Wm. Heinrich and John C. Rabbitt. 40 pp plus maps. Price $1.00.

Directory of Montana Geologists. E. G. Koch, Director. 22 pp

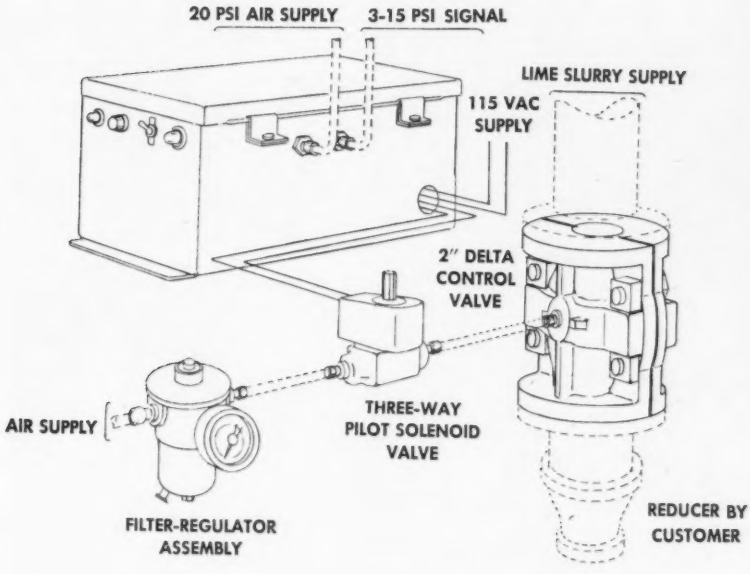
The following publications are available from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.:

Tungsten Deposits of Cochise, Pima, and Santa Cruz Counties, Ariz., Bureau of Mines Report of Investigations 5650, by V. B. Dale, L. A. Stewart and W. A. McKinney. 132 pp plus maps. Price 65¢.

Field Test for Cesium and Rubidium, Bureau of Mines Report of Investigations 5675, by K. C. Dean and I. L. Nichols. 9 pp. Price 15¢

NEW EQUIPMENT

Tomorrow's tools and methods



New Reagent System Simplifies Slurry Additions (24)

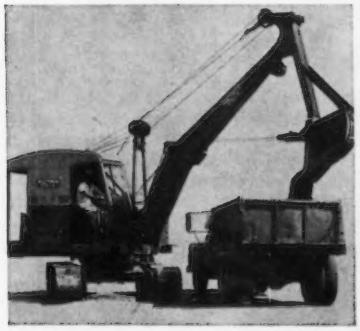
NEW MODULATED reagent system, providing simple, economical, precise control of lime slurry addition to grinding and flotation circuits, has been developed by Industrial Physics & Electronics Co. The system's timer runs continuously—complete cycle every 15 sec—and when the timer contacts are closed, the three-way pilot solenoid valve is energized, removing air pressure from the control valve and allowing it to open.

Control valve has a spilt cast iron jacket with a pair of molded rubber liners. Air pressure causes the liner to collapse with a rolling action and completely close the flow pass age. The valve liner is the only part of the system in contact with the controlled fluid.

Efficient Hand Pump (3)

NEW, EASY-TO-SET-UP, self-priming pump that can deliver 30 gpm is being introduced by Protek Specialty Co. The pump can handle a high percentage of solids, is ideal for pumping muddy water and slurries and can be filled with an interior plastic coating for pumping corrosive chemicals.

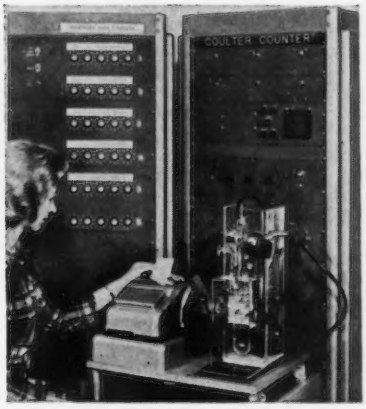
Protek's unit is made of cast aluminum with neoprene diaphragm and valves and weighs 20 lb.



Improved Crane-Excavator (21)

BUCYRUS-ERIE'S new 15-B Series Two crane-excavator has many new and improved features to increase production and reduce operating costs. It's available as a crawler or carrier-mounted unit, fully convertible for crane, dragline, clamshell, hoe, or shovel service.

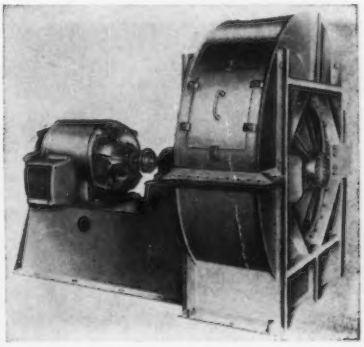
Included in the 15-B improvements are: increased horsepower, wider and longer crawlers; higher capacity brakes; Tri-Ten steel boom and 12-point boom suspension with anti-friction sealed sheave bearings.



Improved Particle Counter (23)

COULTER Electronics' improved particle size counter gathers data quickly and easily and makes size distribution analysis useful for more applications.

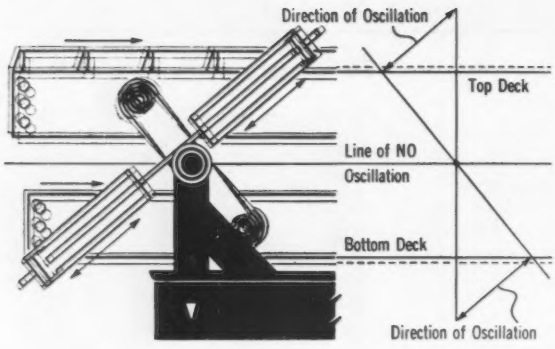
The new Model "C" Counter has a particle micron range from below one to above 200 and features either multiple channel readout, printout or mass per cent graphout automatically.



Industrial Fans (7)

NEW SERIES of heavy-duty industrial fans with airfoil blading, and specifically designed for high efficiency at direct-connected motor speeds, has been developed by the Sturtevant Div., Westinghouse Electric Corp.

The units (Series 8500) are ideally suited for applications such as: combustion air for steel mill and industrial furnaces; packaged steam boilers; and for industrial processes such as glass cooling, vacuum drying and exhaust from aluminum pot lines. Series 8500 is available with capacities from 15,000 to 450,000 cfm and in five a-c direct-connected motor speeds: 750, 900, 1200, 1500 and 1800 rpm.



Improved Vibratory Screen (15)

UNIQUE HORIZONTAL vibratory screen with screening decks that are balanced one against the other—eliminating all dead weight counterbalances—has been introduced by the COMCO Corp.

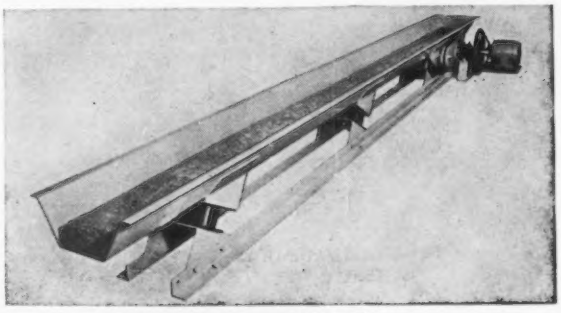
Another new feature is that the screen decks are supported on the base at their center of oscillation (a point of no oscillation) and therefore transmit no vibration to the base frame. The screens vibrate vigorously, yet the frame stays absolutely still (see drawing). Dampeners are not required, and the COMCO needs no special supporting structures.

COMCO screens and conveyors, through the combination of positive eccentric drive and shear-block drive spirngs and connecting rod, rather than with snubbers or other artificial devices, completely eliminate the large erratic start-stop vibrations that are common to vibratory equipment.

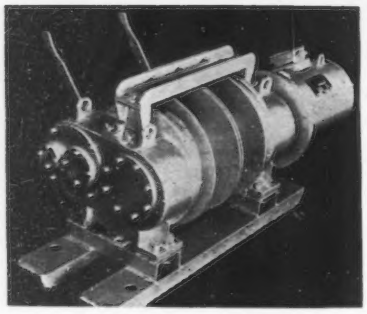
Vibrating Conveyor Mounting (5)

NEW MOUNTING CONCEPT for vibrating conveyors eliminates coil and leaf springs and gives a streamlined, uncluttered unit with lower initial cost, according to General Kinematics.

The trough, Kinematics said, literally floats on the highly efficient rubber mounts to absorb and isolate the material and trough contact effect. Automatic stroke compensation for material load assures continuous, dependable flow regardless of normal surge loads. Kinematics added that the incorporation of the exclusive syncro-flex drive into the unit assures low-cost, trouble-free operation, either for simple material conveyance or as a part of the most complicated processing operation.



E&MJ Monitor



Slusher Drive (11)

THE PILLMAN SLUSHER drive, developed to withstand the punishing conditions of South African mining, is now available in the U.S. and Canada. The unit has a multiple steel disk clutch which does away with an external brake and clutch bands. It is lighter and has higher rope pull per given hp than other comparable drives.

During test conditions in South Africa, 100 Pillman units showed an average maintenance cost of $1.68 per year.

The winches are available in either double or triple drum models in sizes from 10 hp to 100 hp. Air or electric motors are available for the 10-hp units —larger sizes are electric.

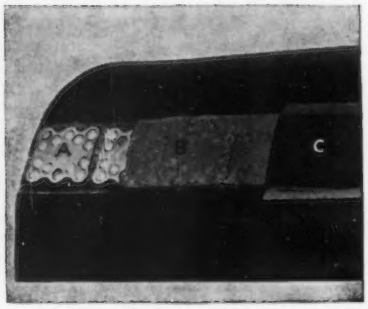
Enlarged Pusher-Dozer (19)

AN ADDITION to the "PAYDOZER" line of rubber-tired pusher-dozers—weighing more than 100,000 lb and reputed to be the largest of its kind now in production—has just been announced by the Frank C. Hough Co.

The model has hydraulic-articulated steering which gives exceptional maneuverability—turning radius is 25 ft, less than the machine's length and one-third less than that of a comparable rear-steer, rubber-tired unit.

Powered by a 700-hp turbo-charged, V-12 Cummins diesel engine, the D-500 "PAYDOZER" has a power-shift transmission that requires no stopping for range shifts. The transmission is a full-reversing, constant-mesh type with speed ranges up to 15 mph in both forward and reverse.

According to Hough, another D-500 advantage is the hydraulic system which is closed and pressure-controlled for maximum protection. The new cylindrical, vessel-type oil reservoir gives added strength and has numerous advantages for this type of application to prolong the life of the hydraulic mechanism.



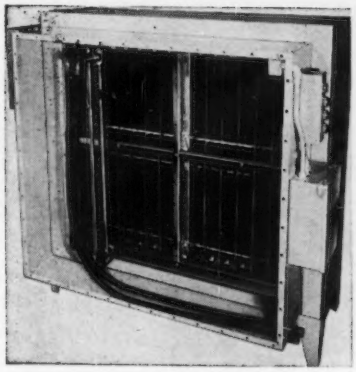
Belt Splice Kit (10)

CRESCENT FASTENER CO. INC. is offering an inexpensive kit which applies a moistureproof belt splice in 1½ hr.

A Crescent belt plate (A) is inserted into the countersunk belt area, then covered by a rubber strip (B), and finally by a rubber patch (C) which is cold vulcanized to the belt surface.

The result, according to Crescent, is a joint that prevents fabric rot and eliminates idler roller wear.

INGERSOLL-RAND CO. recently acquired the Aldrich Pump Co. and will now operate it as a wholly-owned subsidiary. Robert H. Johnson, I-R's chairman and chief executive officer, said the acquisition "is an important step forward in Ingersoll-Rand's diversification program. In addition, the Aldrich products, representing new and different lines, will now be distributed to a broad export market through the existing world-wide sales and service organization of Ingersoll-Rand."



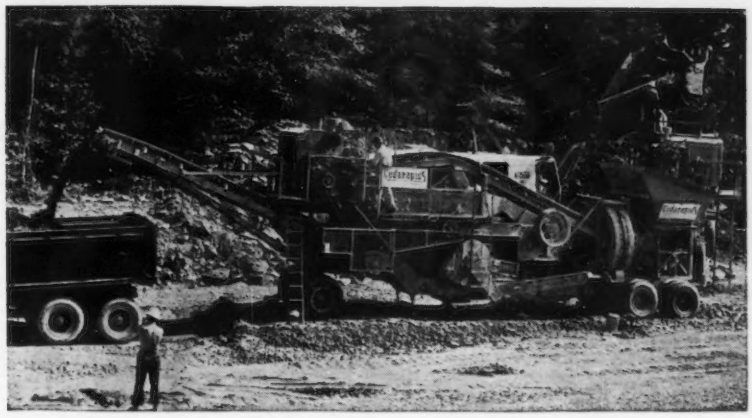
Efficient Air Cleaner (18)

AMERICAN AIR FILTER CO. has developed a completely self-contained high velocity electrostatic precipitator which has completely automatic maintenance and is designed for use in inaccessible areas. Called the Type HVSC Electro-Cell, the new machine will be used with air handling units and is complete with front and back duct connections, drain pan and preassembled washing and oiling mechanism.

Here, according to the company, are some additional HVSC advantages: all insulators are outside the air stream where they remain clean and electrically operative; ionizing wires extend the full height of the collector cell, resulting in more effective ionization; cross-members or sheves within the collector cell have been eliminated to permit a free flow or shelves within the collector cell have collector cell depth—10 in.—is considerably less than that of competitive units, and makes it easier to wash away precipitated dirt.

Speed Reducer (9)

THE SMALLEST UNIT in the Torque-Arm line of fractional hp speed reducers, TD025, is being introduced by Dodge Mfg. Corp. It has a gear ratio of 25 to 1 and will transmit up to .95 hp at maximum recommended output speed of 85 rpm. A predetermined combination of reducer and V-belt drive can provide any speed ratio up to 175 to 1.



Iowa Mfg.'s New Series Combines 18 Crushing Plants (25)

IOWA MFG. CO. has combined 18 versatile models of tandem crushing plants into a new series, Commander, for "easier selection of the correct plant for a specific crushing and screening job." The Commander Series will include: Pitmaster Commander, Models 111 and 211; Junior Commander, Models 322, 332, 422 and 432; Senior Commander, Models 443 and 543; Super Commander, Models 555 and 645; and the Master Commander, Models 557, 657 and 667. The Super and Master Commander plants will be available with either mechanical or semi-electric drives.

Iowa added that a broad line of optional accessory equipment—pre-screening attachment, washing equipment and sand ejectors, and many others—are available.

Flow Regulator (2)

DOUBLE FLOW regulator which features complete pressure compensation, 12 position detents, dustproof dial adjustment, and bottom-positioned ports for simplified installation, has been developed by Fluid Controls, Inc.

The valve has four ports—an inlet, two 0 to 15 gpm regulated ports, and a bypass port. Inlet and bypass ports are ¾-in. pipe, and both regulated ports are ½-in. pipe. The flow from the bypass port can be independently utilized for system functions.

HARNISCHFEGER CORP. and a Brazilian firm have entered into a joint venture to manufacture power cranes and shovels in Sao Paulo, Brazil. As a result of the deal, Harnischfeger said, the first large power shovel ever built in Brazil is now being completed. It is rated as a 1¼ cu yd shovel or as a 25-ton capacity lifting crane, and can easily be converted for dragline, clamshell, or hoe service.

Eight-In. Submersible Pump (1)

GORMAN-RUPP CO. has expanded its submersible dewatering pump line to include an eight-in. unit which has capacity ranges from 1000 gpm (148-ft head) to 2700 gpm (40-ft head).

The new pump, Model S8A1, is 31 in. high, 28 in. in dia, and weighs 775 lb. It's available with 65-hp motor, 1750 rpm, three phase, 60 cycle, 220 or 440 v current.

Screen Tensioning Device (26)

ALLIS-CHALMERS has developed a device that changes vibrating screen decks in only a fraction of the time formerly required and permits tensioning of the wire cloth while the screen is in operation.

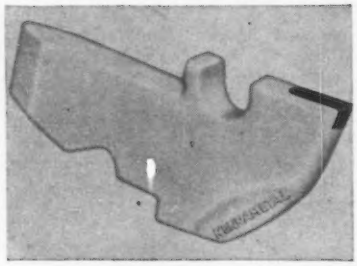
The new fastener provides a 1¼-in. adjustment on each side of the deck. One size fits all types of vibrating screens, which, the company said, greatly simplifies the stocking of parts.

A-C's new device reduces maintenance, lowers operating costs, and is available on all new vibrating screens.

Aluminum Hopper Cars Have Increased Payloads (28)

ALL-ALUMINUM bottom dump hopper trailers which weigh 25% less than conventional 22-cu yd units and which carry 6000 lb more payload per trip have been built by the Converto Mfg. Co. and used to haul coke for J. Artim & Sons, Indiana.

The 32-ft long trailers have a 40-cu yd capacity and, when empty, weigh 8050 lb. The two hoppers are 30 x 72 in. when open. The doors can be closed against the pressure of a full load and are operated by cylinders.

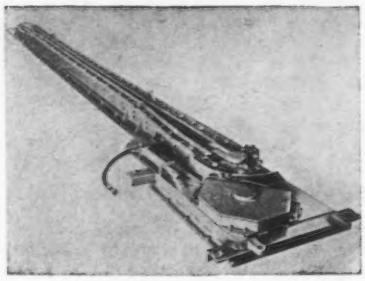


Improved Cutter Bit (22)

IMPROVED CUTTER bit with dual gage shoulder design and a pull-out notch has been developed by Kennemetal Inc.

The notch, which replaces the pull-out shoulder that appears on previous bits, makes it easier, quicker, and safer to extract tools from blocks on ripper-type chains. The dual gage shoulder provides front and rear burning areas that can absorb the severest shock forces.

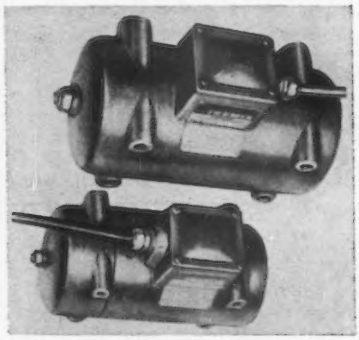
The new bit is called the U21 and, according to Kennemetal, the close dimensional tolerances assure bit stability in the block and positive cutting action.



Medium-Duty Trip Holder (6)

NOLAN CO. is introducing a new medium-duty trip holder that prevents mine cars from moving uncontrollably during automatic loading.

It prevents the drift of cars on level grades or down grades needing under 10,000 lb holding force.



Heavy-Duty Vibrators (17)

CONSIDERABLY SHORTENED shaft between bearings to reduce strain and minimize shaft bending at high speeds is a feature of heavy-duty, electric external vibrators now available from Tremix Co., Inc.

The vibrators come in three compact sizes with impacts ranging from 500 lb to 1400 lb, and are designed to fit bins, chutes, screens, and come equipped with holders for attachment to hopper railroad freight cars.

Tremix said the vibrators are noiseless, totally enclosed with adjustable eccentrics to fit any particular need, and are virtually maintenance free and unconditionally guaranteed.

Improved Air Cleaner (27)

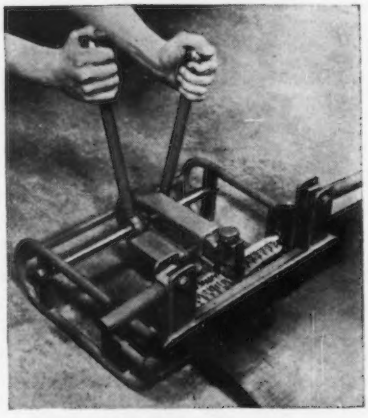
NEW, SINGLE-STAGE, dry-type engine air cleaner is now available in 12 standard sizes for truck, tractor, and stationary engines ranging in power from 10 to over 1000 hp. Made by the Farr Co. and called the Farr Pamic, the new assembly consists of a rectangular housing and a new modular-type filter cartridge. The shape, Farr said, provides room for more filter paper than the familiar "tub".

The enlarged filtration area gives greater dirt holding capacity and a lower pressure loss for the air intake system. In addition, the new design has achieved a 50% to 100% greater service life expectancy for the filter cartridge.

Compact Blaster (16)

COMPACT new blaster, for use with the MD-1 Engineering Seismograph, has been introduced by Geophysical Specialties Co. A few feet of primacord, wrapped around a blasting cap and placed at a measured distance from the MD-1 geophone, can be detonated automatically by the blaster to give seismic readings to a depth of 200 ft or more, depending on the subsurface composition.

E&MJ Monitor



Improved Splicer (40)

NEW TYPE of portable, one-man conveyor belt splicer, the Hayden Zipper, has been introduced by National Mine Service Co. It's adaptable to all belt thicknesses, widths and types, and is a fully portable, lightweight unit which can be easily used in seams as thin as 20 in.

Another Hayden item, the long-reach hook, is the Zipper's companion and grips the belt carcass far back from the edge of the splice. The improved hook construction, combined with Zipper's 7 mm hook spacing, gives sturdier, longer wearing belt splices.

OPERATING BULLETINS

Free aids to better planning

ILLUSTRATED eight-page brochure from Wolman Preservative Dept., Koppers Co., Inc., "Wolmanized Pressure-Treated Mine Ties, Timbers and Lumber," outlines the procedures taken to protect wood against deterioration from rot-producing fungi. Used for above- and below-ground applications, Wolmanized timber provides safer, less hazardous mine operation, improved production, reduced maintenance and operating costs. **(71)**

AUTOMATIC bag-type dust arrestors that collect dust without interruption during bag cleaning are presented in an eight-page brochure from Northern Blower Div., Buell Engineering Co., Inc. The booklet gives design and assembly information; tells how the dust collector operates; diagrams construction details; and tabularizes dimensions and capacities. **(72)**

FIFTY-SIX improvements on the Model 88-B Series Two crane-excavator is outlined by Bucyrus-Erie in its new four-page bulletin. The company says that notable improvements have been made on the machine's revolving frame, deck machinery, power units, air controls, crawlers, and shovel, crane clamshell, dragline front ends. **(73)**

COMPLETE LINE of takeups, in seven frame styles and equipped with sleeve, ball or roller bearings, is described in a new 16-page presentation from Link-Belt Co.

The new publication lists more than 320 different takeup units, and complete information for selection and application with dimensional data for each frame is given. **(74)**

WHAT THE OPERATOR should know about compressor valves is given in an information-packed 40-page booklet from Ingersoll-Rand. The booklet details the demands made on valves and their function in a compressor, and traces the evolution of valving from the mechanically-operated intake valves and heavy poppet discharge valves of the 19th century to the modern high-speed, air-cushioned units. A section of the presentation is devoted to the procedures and equipment used in the manufacture of modern valves, and an assembly line which transforms raw material stock into finished valves is also described and pictured. **(75)**

NEW 44-page electrodes and wires hardfacing brochure, in which all the materials are classified and illustrated according to use, has just been published by Air Reduction Sales Co. The wear protection provided on industrial and construction equipment by Airco hardfacing alloys is discussed in detail and a description of each electrode is presented along with application data. Over 100 specific equipment parts that benefit from hardfacing are listed, together with the type of wear to which each is subject and the alloy needed to protect it. **(76)**

CATERPILLAR TRACTOR CO. has prepared an eight-page booklet to outline the changes from previous model tractors in the D7 and D8 class—demonstrates "how improvements in today's 235 hp D8H and the 140 hp D7D are resulting in greater profit potentials for owners."

Details are given for the D7D touch on the turbocharger, dry-type air cleaner, power train, lifetime lubricated rollers and the exclusive oil clutch. **(77)**

COMPLETE LINE of pneumatic hand tools built by Holland's Grasso Works is now available in the U.S. through Curtiss-Wright Corp.'s Marquette Div. In a new eight-page bulletin, Marquette states that the tools grind, drill, hammer, rivet, cut, and do other specialized operations. The Grasso tools are designed for simple, safe and comfortable operation and long, trouble-free life. **(78)**

THE 24-PAGE June issue of Gelman Instrument Co.'s bimonthly magazine is devoted to detailed discussions of air sampling and radioactivity measurements. The issue contains the following articles: Automatic Sampling on Continuous Tape; Advances in Paper Tape Sampler Design and Accessories; Filters—Pore Sizes and Efficiencies; A Brief Review of Filter Types; Current Improvements in Filter Holder Design. **(79)**

WALWORTH CO. has published a 12-page bulletin, "Flow Characteristics of Lubricated Plug Valves," which supplies accurate pressure drop data on existing valves and makes it possible for operators to calculate pressure drops themselves. According to Walworth, the bulletin helps operators select the most efficient and economical valve for their particular piping needs—lists 85 Walworth lubricated plug valve figure numbers from which the operator may select data and calculate pressure drop with either the K-values or Equivalent Feet method. **(80)**

SIX-PAGE, two-color bulletin describing rotary feeders for bulk materials, chemicals, catalysts, and slurries, under high differential pressures, is available from Beaumont Birch Co. **(81)**

McLANAHAN CORP.'S Super Black Diamond Crusher, a single-roll unit which crushes gypsum, phosphate, shale, slate, and mine refuse, is illustrated and described in a new six-page bulletin. Presentation includes construction data, sizes, crushing capacities and dimension drawing. **(82)**

TWO NEW SHEETS from Goodman Mfg. Co. (G-151 and G-140) describe the 428 continuous borer and the 1070 shuttle car.

The 428 is a single pass machine for full face continuous mining at any height between 6- and 7½-ft, and the 1070 is a large car designed for heavy duty ac service in coal, metal and non-metallic mines. **(83)**

THE 142-C core drill machine is the answer to deep-hole and large diameter diamond core drilling, according to Sprague & Henwood, Inc. Unit's capacities range from 2250 ft for EX drilling to 500 ft with 6-in. x 7¾-in. core barrel, and its advantages include: heavy-duty gear box; over-center clutch; all-steel castings; and new alloy steels at critical points. **(84)**

OVER 1900 ITEMS relating to rotary drilling and soils exploration are

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OPERATING BULLETINS (Continued)

described in Mobile Drilling, Inc.'s 80-page cross-indexed catalog No. 615. Mobile said that an exclusive feature of the new catalog is the water-air selector table which permits drill operators to determine at a glance the correct gpm of drilling fluid or cfm of air needed for rotary sampling and coring. **(85)**

ALUMINUM FURNACE REFRACTORIES, by C. H. Schweinsberg and J. L. Dolph has now been published by Harbison-Walker Refractories Co. as an eight-page reprint. Research methods in the development of refractories for use in aluminum melting furnaces is discussed and each of the materials available to meet a specific operating condition is thoroughly tested to determine which is best suited to the type of application. Test procedures are reviewed and drawings and photos illustrate actual test results. **(86)**

COMPLETE INFORMATION on high pressure multi-stage centrifugal pumps is contained in a new bulletin (722.4) from Goulds Pumps, Inc. **(88)**

McNALLY PITTSBURGH'S newest thermal dryer, the FLOWDRYER, is presented in a new fold-out bulletin which gives a complete description, photographs and dimensional drawings. **(89)**

ILLUSTRATED 16-PAGE brochure describing engineering and construction activities of Kaiser Engineers, "Mineral Industries Services," covers recently completed ferrous, nonferrous and nonmetallic projects in the United States. **(90)**

TWO NEW TYPES of self-aligning and self-lubricating sleeve bearings in flanged and pillow block models that solve application problems of temperatures up to 1000°F are presented in a six-page folder (2823) from Link-Belt Co. The new bearings are ideal for speed installations. **(91)**

THE MATERIALS of construction, sizes, pressure and temperature ratings, dimensions, maximum capacities and minimum flow for actuation of the 11 available styles of Visi Flo sight flow indicators are contained in a two-page bulletin from OPW-Jordan Corp. **(92)**

"FRICTION as a Factor in Bolt Tension, Galling and Seizing," an eight-page article reprinted from Assembly & Fastener Engineering magazine, is offered by the Alpha-Molykote Corp. The article discusses surface geometry of mating threads and the theory of thread lubrication and also presents solutions of actual thread lubrication problems. **(93)**

E&MJ Monitor

KOEHRING'S 605 crane-excavator (1½-yd shovel and 36-ton crane) is described and illustrated in a new 10-page, two-color bulletin. **(87)**

NEW TYPE detachable and reusable fitting for high-pressure hose assemblies, the IRON MIKE, has been developed by Aeroquip Corp. and is described in a six-page fold-out. The fitting is designed for a wide range of high-pressure hydraulic and pneumatic applications, as well as for fuel and lubrication systems. **(95)**

PRINCIPAL SOURCES of metal fatigue, stress, and other troubles have been eliminated on new spun end pulleys made by Stephens-Adamson Mfg. Co. All end plate weldments have been eliminated and, according to the company, the result is a pulley which is stronger than previous types. The pulleys, called "Curve Crown," are available up to 24-in.-dia. **(96)**

NEW 16-PAGE pocket-size reference booklet (No. 1496-V) offers condensed listing of standard and low-pressure gate, globe and angle, check, and special valves, figure number comparison chart, application and installation tips, and other pertinent information about the complete line of Ohio Brass bronze valves. **(97)**

NEW LINE of blast hole drilling rigs (2½ to 7⅞-in. hole size) which operate through a mechanical drive and can be truck, crawler or wheel mounted are described in two bulletins from Le Roi Div., Westinghouse Air Brake Co.

One machine, the LRD-3, is a top drive unit designed to drill 100 ft, and the other, LRD-2, is a lighter rig which drills 30 ft in a single pass with direct drive through the rotary table. **(94)**

ROTARY BURS and files, metal-cutting saws, test instruments, electric etchers, and a complete line of electric motor maintenance devices are listed and described in a 64-page catalog from Martindale Electric Co. The catalog contains dimensional drawings, and prices are quoted on all items. **(98)**

ONE - MAN pushbutton - controlled trackside car shakeout system is outlined in a new bulletin from Hewitt-Robins. Equipment can be operated automatically from remote control station—preventing accidents—and no heavy, suspended equipment needs manhandling into position. **(99)**

NEW INSTRUMENT which may be used as an accurate low pressure deadweight gage or a high range differential pressure manometer is described in a four-page bulletin from ToPaz Inc. The unit is called the ToPazometer and has a working pressure rating of 2000 psi for the standard model, with higher pressure units available upon request. ToPaz claims that the standard and dual scales may be read to 0.1 in. of water or 0.01 psi, and also says the instrument is portable—weighs 26 lb. **(100)**

WESTERN ELECTRIC Corp.'s new wall chart eases the scheduling of equipment shutdown maintenance activities. All items on the 22x27-in. two-color chart are shown at a glance, and space is provided for listing time and manpower requirements. **(70)**

LATEST INFORMATION on Jones horizontal and vertical spiral bevel speed reducers is now available from Hewitt-Robins. **(69)**

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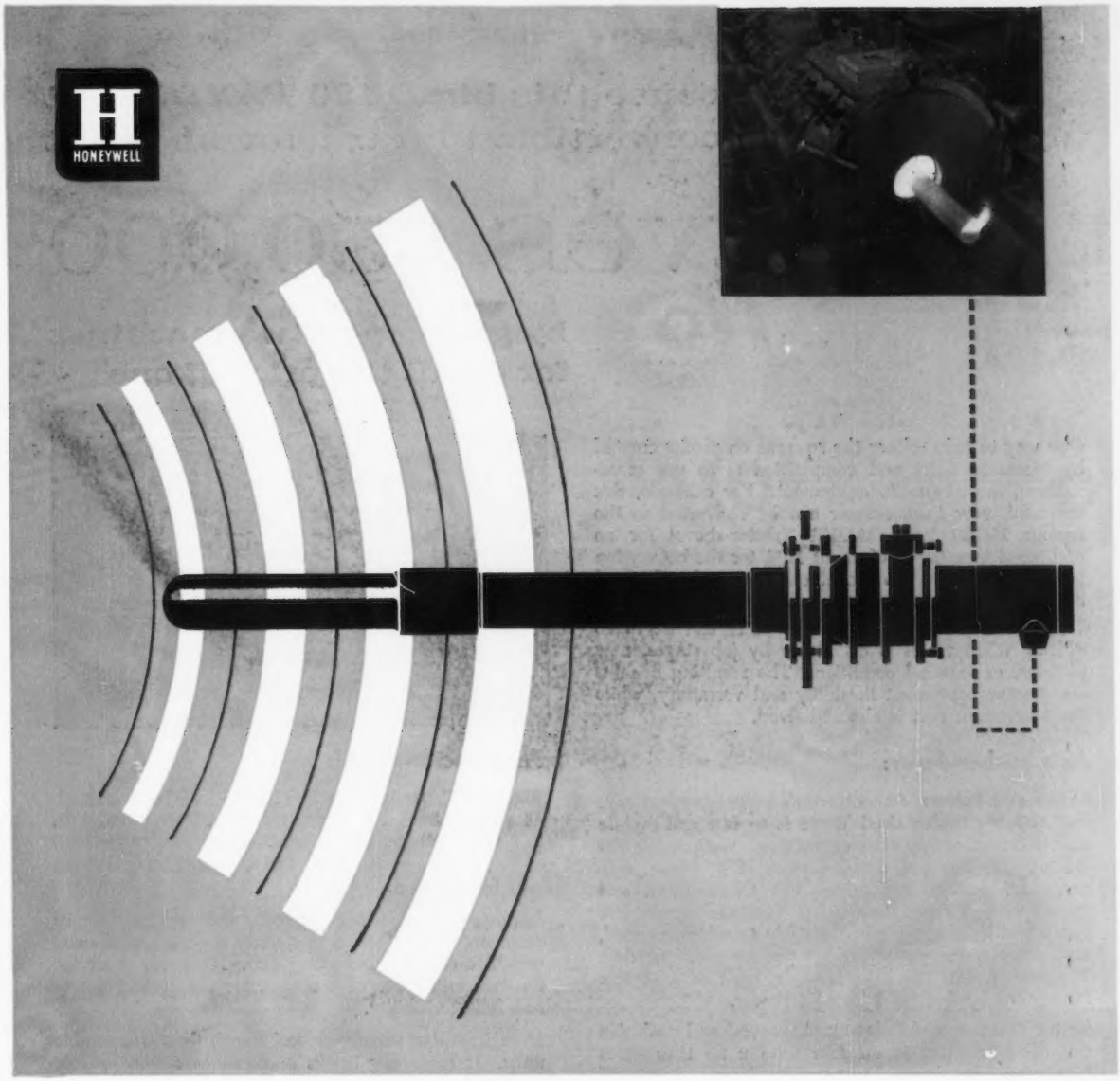

Specify Radiamatic Infrared Detection Systems for dependable, economical temperature measurement and control

For more than 20 years, Radiamatic Infrared Systems have been giving reliable, accurate service in every area of industrial temperature measurement and control. Over the years, Honeywell has developed special infrared techniques and equipment for a wide range of applications, including soaking pits, kilns, heat treating, induction and forging furnaces.

The key to the high accuracy and low cost of these systems is the Radiamatic Infrared Detector. Available in many different models with a full line of accessories, these detectors measure temperatures from 200°F. up to 7000°F.

For complete information on how Radiamatic Infrared Systems can solve your temperature measurement and control problems, call your nearby Honeywell field engineer. Or write Minneapolis-Honeywell, Wayne and Windrim Aves., Philadelphia 44, Pa. In Canada, Honeywell Controls, Ltd., Toronto 17, Ontario.

Honeywell

First in Control

SINCE 1885

HONEYWELL INTERNATIONAL Sales and service offices in all principal cities of the world. Manufacturing in United States, United Kingdom, Canada, Netherlands, Germany, France, Japan.

Because this big D-120 PAYDOZER is convertible to a tractor-shovel it

saves $50,000

by giving you two machines for about the price of one

One way to help relieve the squeeze on profits created by increased costs and competition is to use more-modern, more-versatile equipment. For example, this powerful, new Pusher-dozer can be converted to the famous H-120 PAYLOADER Tractor-shovel for an additional investment of about 10% for the conversion package. In turn, the shovel can always be changed back to the 'dozer.

This conversion from one to the other can be made quickly whenever it is called for by job stages, new projects, or seasonal conditions. The resulting benefits are greater equipment flexibility and versatility, while the investment cost is almost halved.

As a pusher-dozer:

Speed and Power: A contractor's superintendent says that this big rubber-tired 'dozer is so fast and mobile that it "replaces two crawler tractors." With its 59,000 lbs. weight, 300 h.p. diesel engine, 12' 4" blade, full-reversing, 4-range full power-shift transmission, and speeds up to 25 m.p.h. in either direction it can cycle fast while bulldozing, move quickly to where needed, and move tremendous yardage per hour or per day. Blade pitch and tilt adjustment, as well as raise and lower, are by precise hydraulic power.

Better Traction and Balance: Approved and exclusive use of dry ballast in all four 29.5 x 25 tires gives better weight distribution and a lower center of gravity – dampens tire bounce and permits better blade control. Torque-proportioning differentials on *both* axles give the most reliable traction.

Matched Torque Converter: A bulldozer and a loader require different torque-converter characteristics. That's why the converter in this 'dozer is designed specifically to develop maximum dozing effort, and a torque-converter change is a part of the 'dozer-to-loader conversion.

As a tractor-shovel:

Big Load Capacity: The H-120 PAYLOADER is available with bucket capacities from 3¾ to 8 cu. yds. (S.A.E. rated) depending on the materials to be handled. Exclusive, patented Drott "4-in-1" bucket can also be supplied.

Advanced Boom Design includes the exclusive use of extra-strong "T-1" steel that saves over a ton of dead weight on the load-carrying end. All boom parts are forward and clear of the operator for greater safety and fullest visibility.

More Dumping Clearance and Reach than comparable units. It loads big trucks and rail cars more evenly and easier – stockpiles higher.

Easy Operation because of power-shift, power-steer and 4-wheel power air brakes. "Operators'-choice" dual brake pedals – exclusive in its class – lets the operator brake with or without the transmission engaged.

An Experienced Hough Distributor is ready to give you all the facts about the H-120 PAYLOADER and the D-120 PAYDOZER and how their convertibility can save you thousands of dollars in equipment costs.

THE FRANK G. HOUGH CO.
726 Sunnyside Ave., Libertyville, Ill.

Send data on the D-120 PAYDOZER and H-120 PAYLOADER conversion.

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Title _____

Company _____

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6-B-1

HOUGH®

THE FRANK G. HOUGH CO.
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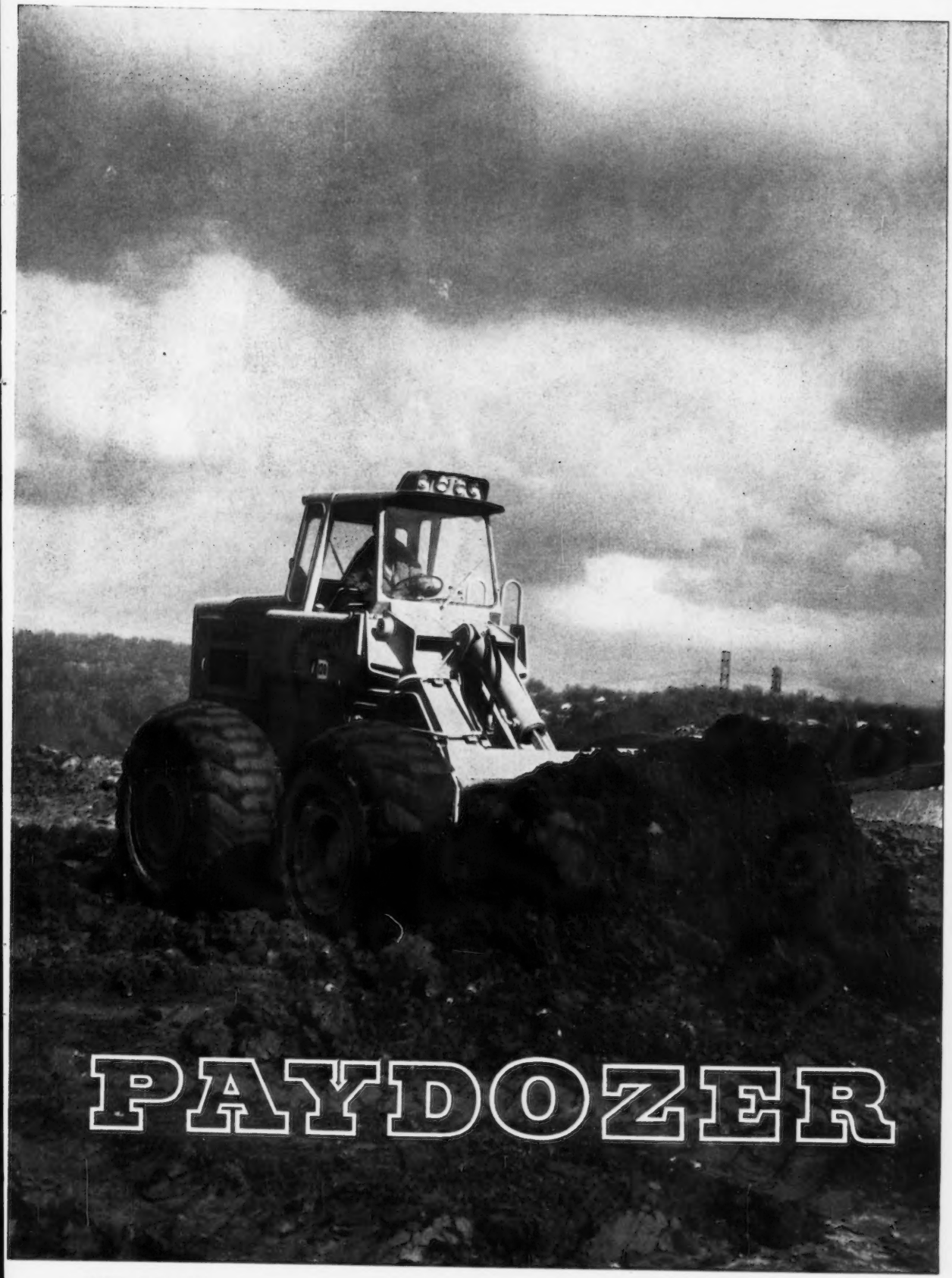
HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.


PAYDOZER

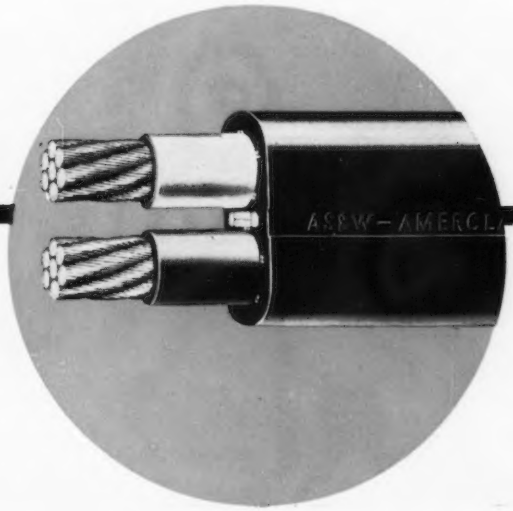
Why USS Amerclad flat-twin outlasts any other mining machine cable

Only USS Tiger Brand Amerclad flat-twin cable offers the unique "Bridgewall" construction that keeps mine shuttle cars on the job longer. Our flat "Bridgewall" cable actually has a thick layer of neoprene between the insulated conductors and the ground strand. This tough, dense layer of neoprene is part of the outer sheath and locks the conductors and ground strand in place. That's why the jacket of Amerclad cable doesn't get loose and baggy. It will stand up to constant rereeling and twisting, crushing impact, snapping tension, and severe abrasion. No other type of construction is so durable.

Flame resistant neoprene is used exclusively for Amerclad jackets. All of these extra-heavy-duty cables are vulcanized in a continuous lead sheath under pressure to insure a tough, smooth jacket. Concentric stranded conductors, made of the highest quality annealed copper, are carefully prestressed and dynamically balanced to eliminate unequal tension without affecting flexibility. You can't buy better off-track cable.

USS TIGER BRAND Electrical Wire and Cable has a standard cable for every special job . . . for information write American Steel and Wire, Dept. 1174, 614 Superior Avenue, N. W., Cleveland 13, Ohio.

USS, Tiger Brand and Amerclad are registered trademarks



American Steel and Wire Division of United States Steel

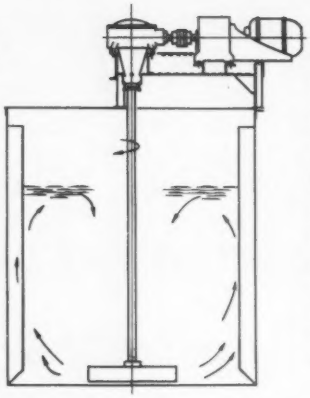
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

6 TURBO-MIXERS HELP WRING PROFITS FROM BY-PRODUCTS AT BLACKWELL ZINC

For more than 20 years Blackwell Zinc Company, Blackwell, Oklahoma, employed secondary processors to recover cadmium from their baghouse dust. For the last three years they have reclaimed the valuable metal themselves, and General American Turbo-Mixers have helped them to realize maximum recovery.

The mixers are used at three stages of the operation: (1) preparation of slurry from products recovered from the baghouse, roasted and ground in a ball mill; (2) copper purification; (3) precipitation of the cadmium sponge.

"Our success with Turbo-Mixers has been such that their continued use will be given



serious consideration on all future expansion for our cadmium plant," says Thomas J. Woods, Chief Engineer.

The secret lies in ability of the Turbo-Mixer to provide optimum control of the variables present while precipitating off the various elements contained in the cadmium-yielding by-product according to Mr. Woods. "In three years' operation, 24 hours a day, they have required a minimum amount of downtime," said Mr. Woods. "Most of it involved only routine maintenance procedures."

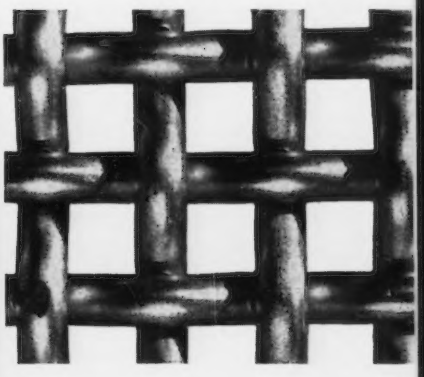
For help concerning your own processing problems, write us.

Process Equipment Division—Turbo-Mixers

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 South La Salle Street · Chicago 3, Illinois · Offices in principal cities

FABRICATED SCREEN SECTIONS TO FIT EVERY VIBRATING SCREEN MADE
Tyler fabricates screen sections to fit every existing type of vibrating screen. This aggregate cloth is drawn from inventory, quickly fabricated to give you fast delivery. Tyler-developed hook strips maintain drum-head tension for long service life.



HEAVY TONNAGE SCREENS
Tyler offers a selection of mesh designs and abrasion resistant alloys to match the requirements of any application in mining and aggregate industries. Check Tyler for technical recommendations.

Wire cloth so finely woven it screens out light!

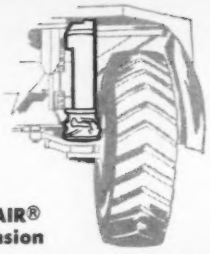
Openings in this woven wire cloth are so tiny they're specified in microns—millionths of an inch. This is Tyler stainless steel wire cloth, 325 x 2300 mesh, used in filtering fuel in aircraft engines. Whatever your special needs in wire cloth, Tyler can supply you from the world's broadest line—covering thousands of different specifications.

TYLER CUTS YOUR COST OF SCREENING

• Requirements matched from world's broadest line of wire cloth • Fast shipments from the industry's largest inventory • Technical service backed by unique Customer Service Laboratory.

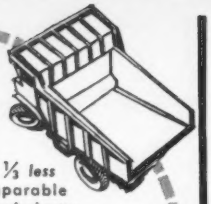
TYLER

THE W. S. TYLER COMPANY *Cleveland 14, Ohio* • OFFICES: Atlanta • Boston • Chicago • Dallas • Los Angeles • New York • Philadelphia Pittsburgh • Salt Lake City • San Francisco • The W. S. Tyler Company of Canada, Limited, St. Catharines, Ontario • OFFICE: Montreal



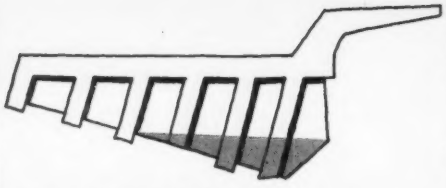
HYDRAIR® suspension

Haulpak rides on air, *not* steel. No springs, no front-axle or related maintenance. Less deadweight. High, 19 to 28-in. ground clearance, short turns. Four simple Hydrair units cushion load and road shocks, keep load riding level.



short turn-circle

Haulpak turns in ⅓ less space than comparable haulers, and *much shorter* than many smaller rigs. You have short wheelbase . . . and sharp-angle turn, because there's no spring or axle obstruction at front wheels.



"bonus-tonnage" V-body

Look at the extra load capacity you get within short wheelbase. Deep V-body carries up to 8 tons of material *below* normal floor-line. Center of gravity is *low*. Exhaust-heated body prevents material from sticking or freezing-in.

Is HAULPAK® different?

You bet it is!

Judge for yourself . . . compare some of these basic Haulpak "differences" against trucks you've been using:

Haulpak, for instance, is so *maneuverable, it U-turns in ⅓ less space than comparable-capacity haulers!* In fact, one owner* says: "Haulpak's short turn-around and high speeds gain us several extra truck-loads a day."

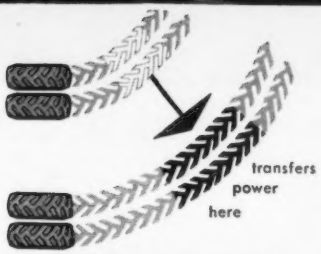
A difference in *speed?* Average top speed of the 5 Haulpak models is *32% faster than the average top speed of all other comparable-size trucks.*

A difference in *safety?* Total brake surface ranges from 3,276 sq in. on the 22-ton Haulpak to 10,186 sq in. on the 60-ton Haulpak. Compare *that* with any other hauler on the market. As another owner* puts it: "From the standpoint of safety, our Haulpaks have it all over the other trucks!"

A difference in *maintenance?* There's not a single spring to maintain on Haulpak. And *no* front axle! All parts are easy to get at; many are interchangeable. And you almost *never* have to grease Haulpak. Reports an owner*: "Haulpak has cut our truck maintenance about in half."

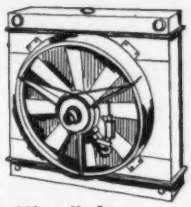
For lowest net cost per hauled ton, check the extra tons per hour, lower operating and maintenance costs *you'll* get with LW Haulpak. 5 sizes, 22 to 60 tons, up to 550 hp. More details, or a demonstration, are yours for the asking.

*Owner names on request.



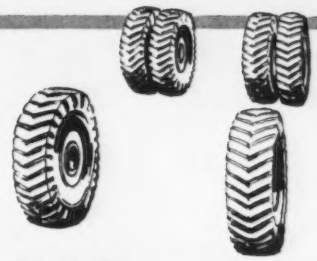
power-transfer differential

Now, for the first time on a truck, you get the LW power-transfer differential. In soft, muddy going, it automatically slows slipping wheels, transfers up to *4 times* the tractive effort to wheels on firmest footing.



"Power-Miser" fan

On the 27 to 60-ton Haulpaks, an aluminum-alloy radiator fan cools engine with *less* than half the hp-drain of conventional fans. Thermostat automatically shuts fan off when not needed, saves its horsepower for extra work-power.



interchangeable components

You operate Haulpak fleets on a *minimum* parts inventory because: All tires can be rotated to any position. Right and left wheels are readily interchanged, as well as right and left Hydrair units.

HP-2373-G-2

LE TOURNEAU-WESTINGHOUSE COMPANY

PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

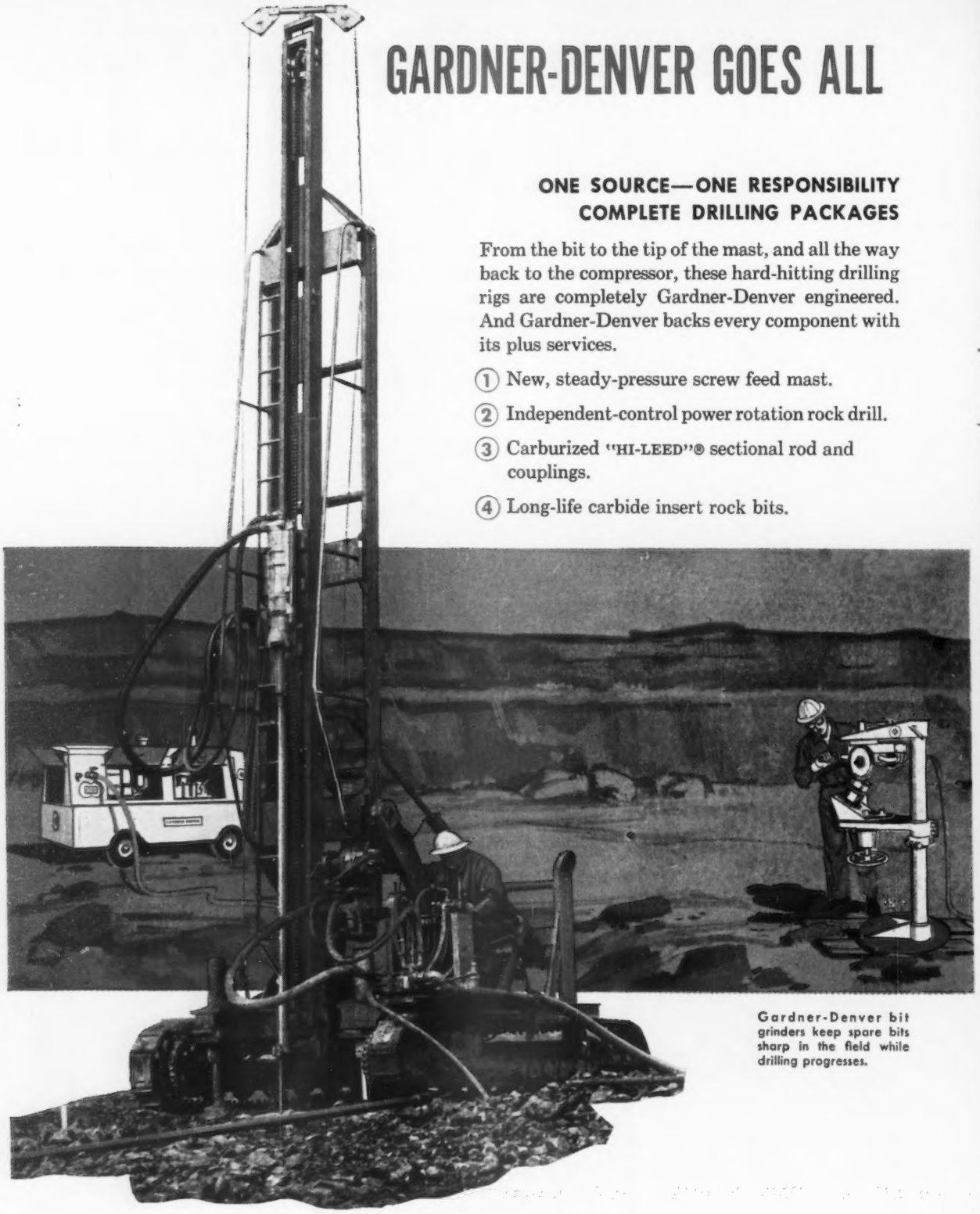
Where quality is a habit

GARDNER-DENVER GOES ALL

ONE SOURCE—ONE RESPONSIBILITY
COMPLETE DRILLING PACKAGES

From the bit to the tip of the mast, and all the way back to the compressor, these hard-hitting drilling rigs are completely Gardner-Denver engineered. And Gardner-Denver backs every component with its plus services.

1. New, steady-pressure screw feed mast.
2. Independent-control power rotation rock drill.
3. Carburized "HI-LEED"® sectional rod and couplings.
4. Long-life carbide insert rock bits.



Gardner-Denver bit grinders keep spare bits sharp in the field while drilling progresses.

THE WAY TO SPEED YOUR BLAST-HOLE DRILLING

⑤ Accurate hole-spotting hydraulic boom and drill positioner.

⑥ Time-saving centralized controls.

⑦ Drill-preserving air line oilers.

⑧ Maneuverable "Air Trac"® crawler.

⑨ Mobile, heavy-duty HT143 crawler.

⑩ Sturdy mast takes 30′ steel changes.

⑪ Hard-hitting, 5½″, deep-hole drill.

SEE YOUR GARDNER-DENVER ROCK DRILL SPECIALIST

New Gardner-Denver Rota-Screw portable compressors start up immediately in any weather or climate. Deliver pulsation-free air flow without compressor vibration. Slash maintenance costs because there are no blades or other touching parts in the compression chamber.

PLUS SERVICES ARE BASIC AT GARDNER-DENVER

Sizes and models to suit job requirements • Specialists to help you choose correct equipment • Demonstrations of equipment in the field • Ready supplies of replacement parts anywhere • Trained technicians to give you mechanical help • Engineered durability and maintenance economy • Pace-setting new products to meet job demands.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

Gardner-Denver Company, Quincy, Ill.—Offices in principal U.S., Canadian and Mexican cities
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NEW DU PONT SUPER "TOVEX" GEL GIVES YOU 20% MORE POUNDS PER FOOT...MORE PUNCH PER POUND

You *handle* it like regular "Tovex" Gel.

You *load* it like "Tovex" Gel – slitting the plastic bag and dropping it in the hole.

You *prime* it as easily as "Tovex" Gel.

But when you *shoot* it, you know it's *Super* "Tovex" Gel – the new non-nitroglycerin gelatin that is now available in a 20% denser grade to help you break hard rock at lower cost.

Not only is Super "Tovex" non-nitroglycerin gelatin 20% heavier per foot of borehole, but it also packs a higher explosive wallop per pound. You can – in many cases – increase your burdens and spacings. So, you save drilling costs.

What else?

Besides higher bore-hole density and more usable energy, here are other ways you can improve your blasting with Super "Tovex" Gel:

More Safety: You operate more safely than with nitroglycerin dynamites.

No Headaches: No ingredient to cause headaches among your blasting crews.

Won't Propagate: Lets you take advantage of short interval delay blasting, even in the most saturated ground... without propagation between holes.

Resists Water: You can expose it to high heads of water for long periods of time.

Loads Easily: Just slit the bag and drop into the hole to get maximum density. A small loading crew can do the job.

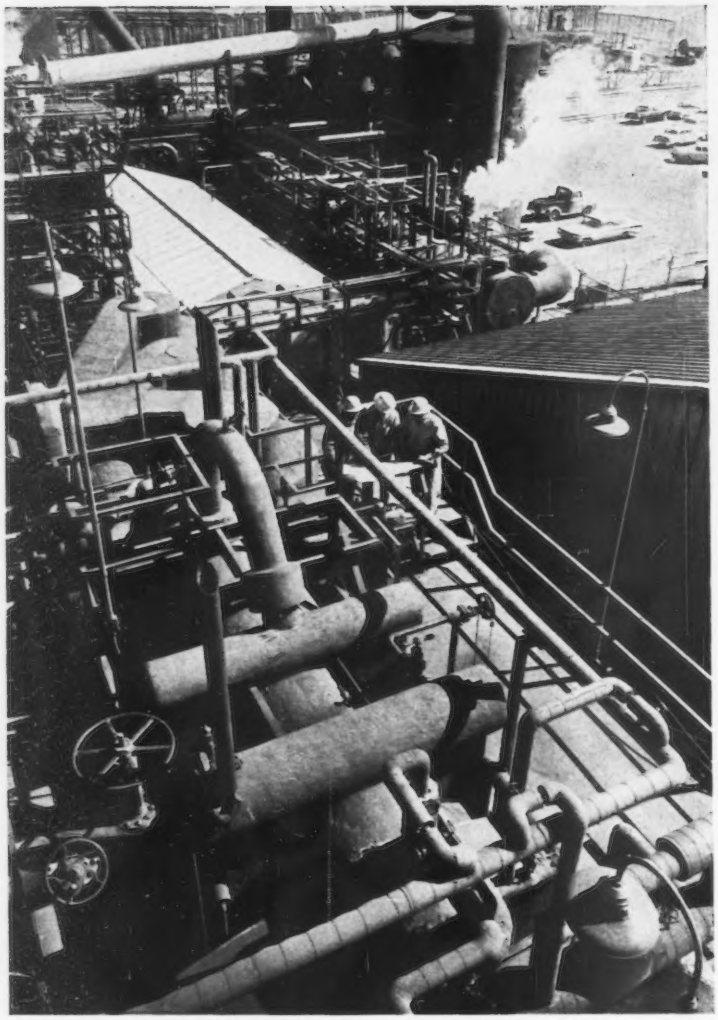
Primes Easily: Can be primed with Du Pont HDP-1 Primers, "Nitramon" Primers, "Nitramite" Primers or "Hi-Velocity" gelatin dynamite.

How soon do you want these savings?

Super "Tovex" Gel is ready now. Your Du Pont Explosives representative or distributor has it. Call him for further information, or write: Du Pont, 2446 Nemours Bldg., Wilmington 98, Delaware.

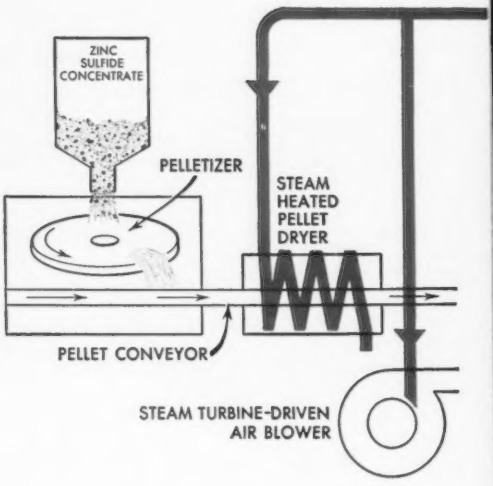
Super "TOVEX" gel

Better Things for Better Living ... *through Chemistry* DU PONT



High output is maintained by water-cooled roaster surfaces which keep boiler tubes slag free, reducing down-time in this B&W waste-heat boiler at Sherbrooke Metallurgical Co. Ltd.

Process steam economically dries and heats the zinc sulfide ore pellets after they are formed on this pelletizer.



Integrated, efficient boiler-roaster system provides HIGH OUTPUT, LOW OPERATING COST PLUS REVENUE FROM

Working closely with New Jersey Zinc Company and Matthiessen & Hegeler, B&W engineers integrated two B&W waste heat boilers with patented Fluid Column Roasters developed by New Jersey Zinc. The result: a highly efficient integrated boiler-roaster system now in operation at Matthiessen & Hegeler's subsidiary, Sherbrooke Metallurgical Company Limited at Port Maitland, Ontario.

LOW OPERATING COSTS Design of the roaster permits efficient utilization of the "self-burning" characteristic of zinc sulfide ore, eliminating the need for any fuel input except during startup. Process steam generated in the B&W boilers is used to dry the zinc sulfide pellets and drive the fluidizing air blowers and other auxiliary equipment.

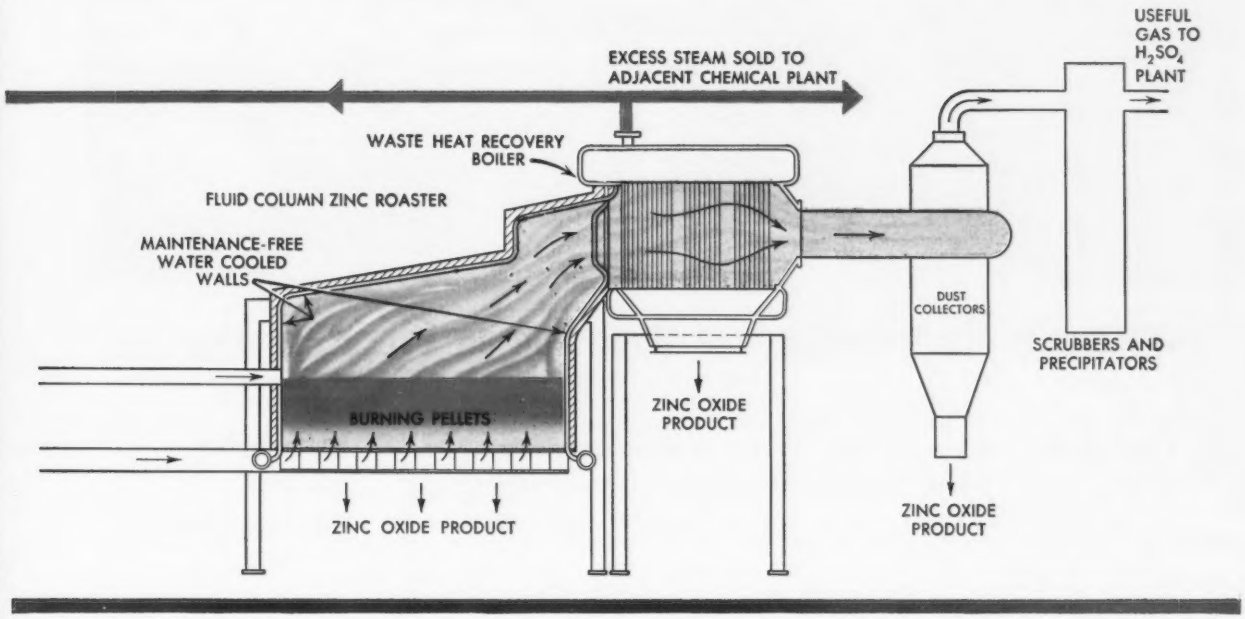
Heat-wasting methods of process temperature control are eliminated by maintenance-free, water-cooled B&W tubular surfaces in the roaster enclosure which replace costly, high-maintenance suspended refractory roofs and flues. It is believed that the waste heat recovery, in pounds of steam per pound of ore roasted, sets a new record.

Erosion is prevented and fluid bed cooling is assured by securing protective blocks to the steam generating tubes below the fluid bed level.

A gas and dust tight enclosure capable of sustaining all process pressure fluctuations is provided with B&W's inner casing design of externally-insulated steel plate welded to the boiler tubes. Canadian

Low operating cost results from self-burning characteristic of ore. Initial fuel firing is provided at start-up by the conventionally fueled burners shown above.

By-product revenue is derived from sale of steam and sulfuric acid to neighboring plants. Recovered SO_2 is converted to sulfuric acid in this acid plant.



BY-PRODUCT RECOVERY *at Matthiessen & Hegeler*

winter weather poses no problems for these outdoor units, as all steel surfaces contacted by roaster gas are maintained at temperatures well above the corrosion level.

BY-PRODUCT SULFUR RECOVERY REVENUE SO_2 gas created in the roasting process is recovered and converted to sulfuric acid. Additional revenue is realized through the sale of this by-product.

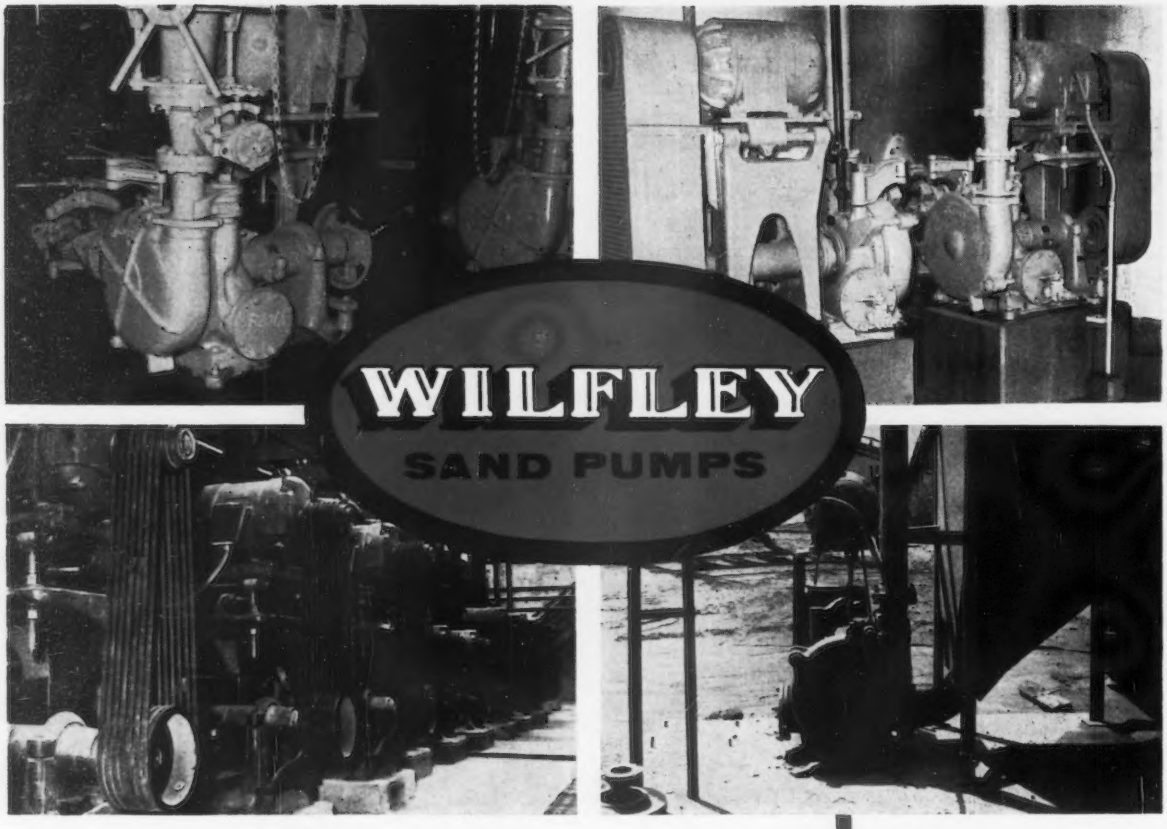
These two new units are the 22nd and 23rd B&W boilers purchased by Matthiessen & Hegeler since 1873.

With advanced engineering developments such as this, B&W – in cooperation with industry throughout the world – is applying the latest engineering developments to reduce processing costs and increase the recovery of useful energy. For more information on effective recovery of waste heat, write for Bulletin G-88. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

ME-105

THE BABCOCK & WILCOX COMPANY
BOILER DIVISION



Continuous, Maintenance-Free Operation on Every Pumping Job

Dependable, low-cost pumping of sands, slimes, slurries — abrasives of all types — is *assured* when you install Wilfley Sand Pumps. They are designed to meet all requirements in the transfer of solids.

If you need belt driven, overhead V-belt driven, or direct driven pumps, Wilfley has them — available in 1″, 1½″, 2″, 2½″, 3″, 4″, 5″, 6″, 8″ and 10″ discharge sizes with capacities to 4000 GPM, heads up to 200′ and higher. They may be fitted with interchangeable electric furnace alloy irons, rubber covered wear parts, special application alloys and synthetic elastomers to best meet the needs of your pumping installation.

Write, wire or phone for complete details.

Install Wilfley, and get maximum pumping economy.

Every Installation is JOB ENGINEERED.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

A. R. WILFLEY and SONS, INC.

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ENGINEERING AND MINING JOURNAL

JULY 1961

We're Not Asking for Favors . . .

IN LATE MAY THE MINNESOTA LEGISLATURE turned down a proposal of the iron ore mining industry to write a tax equity guarantee for taconite and semi-taconite processors into the state constitution. In the proposed amendment, to be voted on by the electorate in 1962, industry requested that taconite and semi-taconite processors would pay taxes at a rate no higher in the future than other industries pay in the form of corporate income taxes.

The reason for this request is obvious. Taconite and semi-taconite projects require long-term investment of hundreds of millions of dollars, and once established they are there to stay—for fifty years or longer. Steel and iron-ore mining companies simply do not have hundreds of millions in idle cash lying about, and must borrow from insurance companies or other sources at interest costs running into millions of dollars per year.

Now if the steel and iron ore companies must assume the legal and financial obligations to bring multi-million-dollar taconite projects into production, it's only logical that they should expect state governments to assume a comparable degree of responsibility. What, for instance, would prevent some capricious, liberally-oriented future state legislature from lowering the tax boom on mining companies once they had invested hundreds of millions in the state in plants and properties that cannot be moved out as easily as automobile or shoe factories? Surely nothing could be more fair or a better expression of good faith than a constitutional amendment designed to treat the taconite industry as fairly as Minnesota treats all other industry. That's all that the taconite industry is asking—nothing more.

Liberal opponents to the tax amendment sponsored a resolution through the House stating that it was the legislative policy to continue taconite tax incentives into the future, and the Senate concurred shortly after. Now, in 1941 Minnesota did give tax incentives to Erie Mining Co. and Reserve Mining Co. which resulted in the investment of nearly one-half-billion dollars in taconite projects. But just how much of an incentive was this tax relief? For an answer we quote the following excerpts from a talk on the "Lake Superior Iron Ore Industry—Its Problems—Its Possibilities," by Robert Linney, president Reserve Mining Co., before an AIME meeting in Duluth Jan. 9, 1961:

"I believe there are many who think that taconite in Minnesota pays little or no taxes . . . others think these taconite companies pay on the Taconite Tax. The truth is—and it's our responsibility to see that we get this message to all concerned—taconite is a big taxpayer.

"The company I am associated with—Reserve Mining Co., alone, has been paying approximately $2-million each year in State and local taxes, and for 1960 this tax bill may go close to $2.5-million! Here is a listing of Reserve's estimated Minnesota State and local tax bills for the year just ended, not including any State unemployment taxes and, of course, not including Federal taxes:

Taconite tax	$ 320,000
Taconite Railroad tax	400,000
Occupation & Royalty tax	540,000
Special School tax	1,055,000
Ad Valorem tax	50,000
Total for 1960	$2,365,000

"The public does not know that our other Minnesota State and local taxes for 1960 will run seven times as much as the Taconite Tax alone, and as our scale of operation increases and our operating margins improve, *as they must,* our taxes will increase in a corresponding degree.

"Reserve has been in operation for only five years, and instead of paying practically no tax—as some might assume, indeed, as some people have stated—Reserve's total state and local taxes paid in Minnesota during its short life, including our 1960 taxes, amount to approximately $10-million.

"As a matter of fact, we believe that Reserve Mining Co. pays the biggest State and local tax bill of any company in the State of Minnesota—except for utilities, railroads and several iron ore mining companies, of course. The significance of this comes to me when I think of some of the big manufacturing companies which are located in the State of Minnesota. Known world wide, employing up to six times as many people in the State as Reserve employs, old established companies—yet none of them pays as big a state and local tax bill as Reserve Mining Co.!

"Beginning back in 1941 with the passage of the Taconite Tax Law in Minnesota, much special legislation has been enacted for taconite. It was designed to attract this new industry . . . and to establish conditions which would encourage its growth and help it in one of the toughest competitive battles American business knows today.

"The people and their elected representatives were willing—*eager*—to enact this enabling legislation because they recognized the importance of payrolls. They were willing to trade taxes for payrolls. From what I have told you, I'm sure you'll agree they made a mistake. A *glorious* mistake. They got the payrolls . . . and THEY GOT TAXES, TOO!

"Don't misunderstand me. Reserve is not demanding that its taxes be reduced. We believe we have received fair and understanding treatment from the State. Reserve has been comparatively free from both state and local controversies over tax and legislative matters. *But we do want* to dispel any notion that taconite is getting a free ride."

(EXHIBIT I)
Hypothetical

CALUMET DIVISION - CALUMET & HECLA, INC.

COST REDUCTION PROPOSAL

Prop. No. 60DL36.4
Date Apprvd 7-25-60
Project No. 21.50
Div. Name Mining
Dept. Name 36 Mohawk
Issue Date 7-20-60

Description of Operation: Stope mining

Present Method: Cut 5' x 5' chute hole - build wood chute --overcut to full width of stope--load cars from chute.

Proposed Method: Slab across stope creating bench-start stope 20 ft. wide--leave 10 ft. level pillar--overcut to full stope width after level pillar is formed--load cars with bucket loader.

Operation or Material	Std. Hrs./Ton	Cost* /MH			Cost/ Ton	Operation or Material	Std. Hrs./Ton	Cost* /MH			Cost/ Ton
Director Labor						Direct Labor					
Mining Labor	.164	$2.75			$ .451	Mining Labor	.125	$2.75			$ .344
Tramming Labor	.052	2.40			.125	Tramming Labor	.056	2.40			.134
Scraping Labor	.087	2.20			.191	Scraping Labor	.087	2.20			.191
Material	Cost/Ft.	Tons/Ft.				Material	Cost/Ft.	Tons/Ft.			
Powder	$.0603	.30			.201	Powder	$.0603	.38			.158
Cap and Fuse	.0216				.072	Cap and Fuse	.0216				.057
Bits	.0183				.061	Bits	.0183				.048
Steel	.0096				.032	Steel	.0096				.025
Machine & Leg	.0162				.054	Machine & Leg	.0162				.043
Chutes	.0132				.044	Chutes	-				-
Loader	-				-	Loader	.0209				.055
*Includes fringe benefits											
1. Total Present Cost/Ton					$1.231	2. Total Proposed Cost/Ton					$1.055

ANTICIPATED RESULTS	3. Variable Savings Per Ton (1 minus 2)	$ .176
	4. Estimated Annual Production Volume	300,000 tons
	5. Estimated Annual Savings (3 x 4)	$ 52,800
	6. Estimated Installation Cost Expense	$ 5,000
	7. Estimated Recovery Period (6 ÷ 5)	.1 years

ATTACH SEPARATE SHEET WITH SKETCHES OR ADDITIONAL DATA (WHEN REQUIRED)

THE PROPOSAL FORM lists the present method and the proposed improvement, with their relative costs and anticipated results. Department heads sign agreement on the reverse side or indicate reasons for their disagreement.

How Industrial Engineering Helps To Cut Costs at Calumet & Hecla

ROGER F. BREDIN

WHEN IT INITIATED its cost reduction program, the Calumet Division of Calumet & Hecla, Inc. first tackled the area of management responsibility and support — the obviously necessary base for any such project.

After informing top management of the objectives and potential of the program, the Division enlisted the double-barrelled talent of supervisors and the Industrial Engineering Department on a joint responsibility basis.

The IE men could then combine their specific training in methods and cost analysis with the supervisors' knowledge of operations, giving the latter a vital assist in meeting the responsibilities of cost reduction. And this, in turn, meant close cooperation between supervisors and industrial engineers in first trying and then following through on new method changes. To back up this co-ordinated program, all supervisors, who had already been trained in work simplification, took refresher courses, insuring some common understarting between them and the IE Department.

Cost reduction is defined in C&H's terms as that reduction derived from methods improvements, such as a change in equipment which allows reduction in labor. The procedure is divided at C&H into "developed" and "installed" cost reduction; the latter where a plan has been put in place and the former where a plan has been investigated, analyzed and tested on the planning board.

The first step, after management organization, is the establishment of an "annual developed cost reduction goal," based upon management emphasis and supervisory and staff effort, skill and attitude.

Each supervisor is asked next for a cost reduction goal for his department. He is assisted by the IE Department, but the final figure must

Mr. Bredin is manager of Industrial Engineering, Calumet Division, Calumet & Hecla Inc.

DEPARTMENT COST REDUCTION REPORT (EXHIBIT II)
Hypothetical

Month July Year 1960

Division Mining Department 36 Mohawk

1.	Developed Cost Reduction Goal – Annual	$100,000
2.	Developed Cost Reduction Goal – Year-to-date	58,333
3.	Cost Reduction Proposals Developed – This Month	52,800
4.	Cost Reduction Proposals Developed – Year-to-date	72,448

Note: Comparison of item 4 to item 2 and to Item 1 indicates progress towards cost reduction goal.

Item 3 is based on the following proposals:

Proposal No. 60DL36.4 – Chute Stoping vs. Open Stoping at No. 36 Mohawk

5.	Cost Reduction Proposals Installed – This Month	$ 6,556
6.	Cost Reduction Proposals Installed – Year-to-date	48,421

Item 5 is based on the following proposals:

Proposal No. 60M36.1 – 1" x 8" No. 1 Gelodyn vs. 1-1/8" x 8" 60% Giant Gelatin in Stopes and Raises.

J. D. Green
Department Manager (1)

DISTRIBUTION: Division Director (1)
File (1)
Industrial Engineering Department

CALUMET DIVISION EXHIBIT III
Calumet & Hecla, Inc. (Hypothetical Figures)
Month July Year 1960

		DIVISION			
		Total	Mining	Metal P & F	Engineering
1a.	Developed Goal – Annual	$250,000	$150,000	$70,000	$30,000
b.	Developed Goal – Year-to-Date	145,833	87,500	40,833	17,500
2a.	Proposals Dev. – This Month	56,360	52,800	2,780	780
b.	Prop. Dev. – Prev.Mo.Curr.Yr.	126,312	59,745	38,739	27,828
c.	Curr. Yr. Prop.Cancelled-This Mo.	None	None	None	None
d.	Proposals Dev.Curr.Yr.-to-Date	182,672	112,545	41,519	28,608
3.	Proposals Installed – This Month	12,252	6,556	1,352	4,344
4.	Proposals Installed – Yr.-to-Date	109,835	53,068	35,015	21,752

(Comparison of item 2d to 1a and 1b indicates progress towards cost reduction goal.)

I. Cost Reduction Proposals Installed This Month

Date Approved	Prop. No.	Description of Proposal	Appr. Req. No.	Est. Install. Cost	Est. Annual Savings	Current Status
4-30-60	60M36.1	10.1.4-1"x 8" No. 1 Gelodyn vs. 1-1/8" x 8" 60% Giant Gelatin in Stopes and Raises-No. 36 Mohawk	None	None	$6,556	Installed July 1960
5-5-60	60M54.4	Change Type Babbit in Crusher Roll Bearing Cap: No. 54 Calumet Mill	None	None	1,352	Installed July 1960
6-21-60	60M30.5	Star Break No. 6 vs. Peninsula Coal-No. 90 Calumet Boiler Plant	None	None	4,344	Installed July 1960
		5. This Month		None	$12,252	
Total		6. Prev. Months (Line 7-Last Mo.)		$20,971	$97,583	
		7. Year-to-date (5-6)		$20,971	$109,835	

II. Active Uninstalled Cost Reduction Proposals Developed This Month

Date Approved	Prop. No.	Description of Proposal	Appr. Req. No.	Est. Install. Cost	Est. Annual Savings	Current Status
7-6-60	60MS89.1	46.1.9-Repair and Replacement of Reaction Tanks 1& 2-No.89 Leaching Plant	090-227	$5,420	$2,780	Install Oct. 1960
7-16-60	60E84.3	Block & Tackle vs. Switch Engine to Reposition Railroad Scrap Car-No.84 Railroad	None	125	780	Install Aug. 1960
7-25-60	60DL36.4	2.1.50-Open stoping vs Chute Stoping-No.36 Mohawk	To be issued-Expense	5,000	52,800	Install Mar. 1961
Totals		8. This Month		$8,545	$56,360	

III. Active Uninstalled Proposals Developed in Previous Months (Current and Prior Years)

7-23-58	8E42.1	15.1.2-Installation of Spur Track for Ore Haulage-Eliminate Trucking-No.42 Cliff	To be issued-Capital	$24,000	$12,746	Pending transfer to production mine
5-12-59	9E54.4	45.1.37-Installation of Classifiers and Thickeners to Recover Elevator Shovel Wheel Overflow-No.54 Calumet Mill	To be issued-Capital	8,400	9,320	Pending capacity check of classifier
2-20-60	60IL36.1	Semi-automate 3 U.G. Pumps-Eliminate Pumpman Labor-No.36 Mohawk	0792-241 Capital	24,620	18,542	Install Dec. 1960
3-13-60	60E54.3	45.1.46-Steel vs. Wood Copper Concentrate Tanks-No.54 Calumet Mill	None	None	496	2 Installed 6 remain to be installed as required
4-15-60	60MS98.4	Microfilm Engineering & Geology Tracings, etc. Eliminate Insurance Premium-No.98 Engineering	None	1,624	2,542	Pending availability of machine
5-19-60	60E28.4	50.1.2-Ordinary Traps vs. Steam Purifier and Multiport Drainers-No. 28 Calumet Power Plant	To be issued-Capital	11,421	13,841	Being considered for 1961 Planned Expenditures
6-24-60	60DL30.4	4.1.90-One Trammer, One Scraper vs. Two Loaders, One Trammer per Double Tram Point-No. 30 Mandan	None	None	27,480	Waiting complet. of ventilation on 49N
		9. Active Uninstalled Proposals Developed in Previous Months		$70,065	$84,967	
		10. Active Uninstalled Proposals Developed This Month (Line 8)		$ 8,545	$56,360	
		11. Grand Total Active Uninstalled Proposals (9 + 10)		$78,610	$141,327	

IV. Reconciliation of Uninstalled Cost Reduction Proposal Inventory

12.	Active Proposals Reported Last Month (Line 11-Last Mo.)	$70,065	$97,219
13.	Active Uninstalled Proposals Developed This Month (Line 8)	+ 8,545	+ 56,360
14.	Proposals Developed and Installed Month	+	+
15.	Proposals Installed This Month (Line 5)	– None	– 12,252
16.	Proposals Cancelled This Month		
	a. Current Year Proposal No.	–	–
	Proposal No.	–	–
	b. Previous Year Proposal No.	–	–
	Proposal No.	–	–
17.	Grand Total Active Uninstalled Prop. (Line 17 must reconcile with Line 11)	$78,610	$141,327

Reason for Cancel

B. C. Johnson
Industrial Engineering Manager

AFTER A COST REDUCTION PROJECT gets under way, each department involved, as shown in Exhibit II, reports its monthly savings, its progress toward the year's goal, and any newly initiated proposals. Exhibit III presents a hypothetical breakdown of the various method improvements and the corresponding savings, plus projects still dormant.

be his own. The goals are then summarized by their respective area and division: mining, processing and fabrication, and engineering.

Meetings are held once a month with each department that has a goal, to discuss projects which are under investigation and new projects which are to be investigated. Minutes of these meetings are distributed to all concerned. Ideas of all departments are reviewed for possible application in other than the originating department.

The Three Forms

The first form in use is the Cost Reduction Proposal Form (Exhibit I). Its general purpose and use is to display the proposed change in method. It includes a description of the present and proposed methods; a summary of costs for present and proposed methods; a summary of anticipated results, such as annual savings and recovery period; and lists additional intangible benefits, if any. It provides a reference file of developed proposals which can be used for follow-up of active uninstalled proposals in subsequent studies.

When a new method is proposed, a member of the Industrial Engineering Department will investigate the proposed change and obtain the necessary data to complete the cost reduction proposal form. The form will then be circulated to line management of the department involved. Each will have the opportunity to review the proposed change along with the cost figures. After review, the supervisor is to check whether he agrees or disagrees with the proposal. If in disagreement, he should state his reason, being specific. Space is provided for additional comments, if needed. When the proposal is approved, an estimated installation date will be established. If necessary, an appropriation request will be initiated to cover installation costs.

Some advantages of the form are that it gives operating personnel the opportunity of reviewing the complete proposal before it is issued. It requires their signature and approval (or disapproval). It also requires that an estimated installation date be given, which normally speeds installation. It establishes at least a semi-standard procedure for calculation of savings, and provides a convenient file for review of installed or uninstalled proposals.

The proposal numbering system is coded to show the year in which the proposal is developed; the cost area in which the reduction is effected, that is, material, labor, etc.; the department in which it is to be installed; and the number of a particular type of proposal developed during the year. This will indicate the trend of development in the various areas during the year.

Distribution for a mining department proposal is normally made to the mine captain, mine manager, mining director, accounting manager, and industrial engineering. If an appropriation request is required for approval of expenditures, a copy of the cost reduction proposal is attached for justification purposes. Distribution is made to all operating and staff members who will influence the prompt and successful installation of the project.

The second form (Exhibit II) in use is the Department Monthly Cost Reduction Report. This report is issued to each department which has established a cost reduction goal. The report concerns cost reduction progress for that department only and contains the annual and year-to-date developed cost reduction goal. It also indicates the savings for cost reduction proposals developed in the current month and year-to-date and the proposals installed in the current month and year-to-date.

The purpose of the individual department report is to give the manager of each department a clear picture of his progress toward the cost reduction goal for his department. It gives industrial engineering, as well as the operating division head, a quick review for determining which departments may need more emphasis.

The third and last form (Exhibit III) is the Division Monthly Cost Reduction Report, which summarizes the progress in cost reduction through methods improvements for the total Division. It includes the annual and year-to-date developed cost reduction goal. For our purpose, the year-to-date figure was programmed equally by allowing one-twelfth the annual goal for each month. If, on the other hand, we had been planning to add industrial engineers to our staff during the year, the goal would have been programmed unequally, allotting heavier savings to those months receiving additional industrial engineering coverage. Included in the report are annual savings for proposals developed during the month and proposals installed during the month, also proposals developed year-to-date, and proposals installed year-to date. The report indicates monthly the progress toward the established goal. It provides convenient follow-up of uninstalled cost reduction proposals, describing the current status of each proposal. It indicates the current uninstalled cost reduction potential of the Division. The report is distributed to the president and general manager, the Division directors, and the accounting department.

Possible Developments

Some preliminary work has been done with the accounting department in establishing a procudure whereby it will provide a report showing actual savings versus estimated savings. Problems exist here in that actual costs, in many cases, are not accumulated to coincide with the cost elements of the proposed method. When this occurs, special accounting arrangements would be required for their accumulation. Another considertion is the interpretation of actual savings as indicated by this type of report. Any judgment of results has to be tempered by recognition of variables such as vein thickness, penetration, dirt inventory, ground condition, etc. which currently exist within a mine, and effect operating costs. It is believed that these problems can be overcome and that this report will prove to be a worthwhile development.

A second possible development is the incorporation of planned cost reduction projects in the annual Division budget. These are projects which are expected to be installed in the coming year. This figure, plus an estimated amount of cost reduction that will be developed and installed in the coming year, will make up the "installed cost reduction" goal and budget for the year.

Thirdly, it is expected that development of a supervisory incentive program which would include performance against the installed cost reduction budget in calculating payment, would raise cost reduction effort to a maximum.

By emphasizing the responsibility of supervisors toward cost reduction, by having them set their own cost reduction goals, developed cost reduction has been increased by 75% at Calumet & Hecla over the previous two year average. Installed cost reduction has been increased by 150%, over the same period.

The system keeps supervision and top management constantly aware of their progress in cost reduction, both individually and collectively, and of equal importance, it develops more co-operation between industrial engineering and operating supervision.

(For comparison and contrast with industrial engineering savings in an open pit operation, see B. Blain Bradford's article on Kennecott Copper's Bingham, Utah, mine in E&MJ, May 1961, p 93-95.)

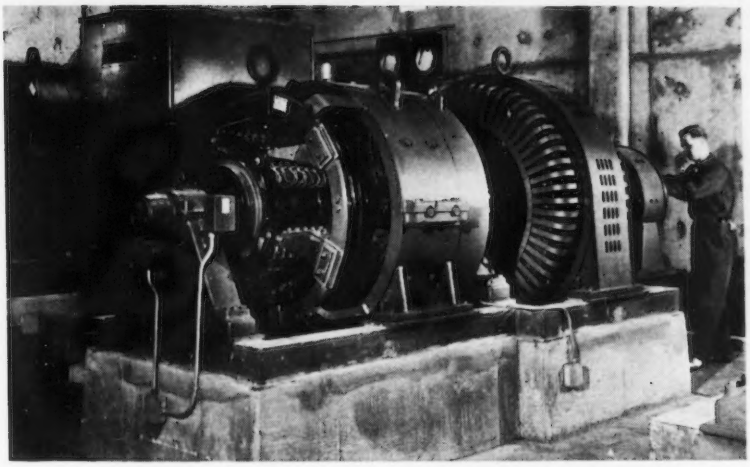


FIG. 1 CONVENTIONAL MOTOR-GENERATOR set. For underground installations M-G sets can be mounted on rail cars to bring dc power close to working places.

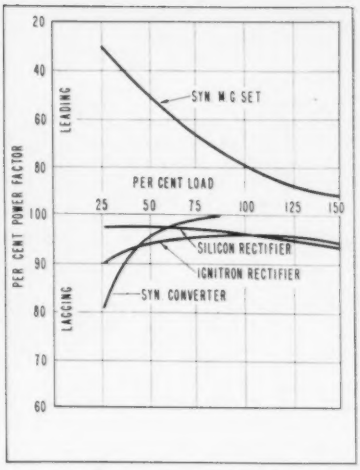


FIG. 2 SYNCHRONOUS M-G sets can correct power factor, improve costs.

What the Mining Man Should Know About Power Conversion

SPECIAL REPORT

CHARLES G. CLOERN
CLARK B. RISLER

THE ADVANCING ELECTRICAL technology has made numerous types of power conversion equipment available to the mining industry. As a result, seven types of devices currently require consideration for a mining power conversion problem. To assist in selecting the proper of seven available conversion units, "thumbnail" descriptions will be presented for each type of conversion device. These will be followed by a review of the requirements of specific mining duties and a suggestion of the appropriate conversion apparatus to be used.

In selecting the proper conversion equipment to supply a mining requirement there are four basic decisions to be made:

1. Location—where the conversion equipment will be placed.
2. Type—of equipment best suited to the requirements.
3. Rating—in kilowatt and voltage of each unit.
4. Number—of conversion units required.

In making each of these decisions, five factors must be considered:

1. Operating characteristics of the conversion equipment.
2. Suitability of the equipment for the environment.
3. First cost both of purchase and installation.
4. Operating cost—efficiency, power factor, maintenance.
5. Ease of operation, installation and maintenance.

To evaluate these factors, the nature of each conversion device should be reviewed and its features compared with the requirements.

Mr. Cloern is power conversion engineer, and Mr. Risler is mining industry engineer for Westinghouse Electric Corp., East Pittsburgh, Pa.

Conversion Units in Brief

Motor-Generator Set

The motor-generator set consists of one or more conventional rotating dc generators driven by an ac motor, as shown in Figure 1. These are independent machines connected by flexible couplings and mounted on a common bedplate.

For underground applications, the motor and generator can be mounted on a rail car. An additional car is required for the associated control and switchgear. This arrangement facilitates moving the equipment for ever-changing underground operations.

Starting equipment of either the switchgear or industrial control type is required for the ac motor. The generator must have a rheostat and voltmeter for adjustment of the dc voltage and a main feeder circuit breaker to protect it against excessive currents in case of overloads or short circuits in the dc system.

The ac motor is often of the squirrel-cage type. Such motors offer the most rugged construction and permit the simplest and least expensive control. On larger motor-generator sets, synchronous motors, operated at 0.8 leading power factor, can compensate for lagging power factor loads as shown in Fig. 2. This will improve the distribution system performance and lower power costs and frequently warrant the higher cost and complexity of a synchronous motor and its control.

Motor-generator sets are available with generator ratings from one to several thousand kilowatts at voltages from 15 to 600 v. The motors operate from 480, 2400, or 4160 volt, 25 or 60 cycle ac systems as required. The units operate over normal range of rotating machine temperatures from 40 degrees C rise with Class A insulation to 60 degrees C rise with Class B or Class H. Generators less than 101 kilowatts are made today with Class H insulation. Those of earlier manufacture are to be found with either Class A or Class B. The generators are designed with a peak load capacity of 150 percent for two hours and 200 percent for one minute. The limiting factor is the commutating ability of the dc generator, and the ability of the ac driving motor to provide adequate torque during peak loads.

The voltage of the dc generator is a function of the armature speed and field strength. The ac motor maintains constant speed with constant frequency over a relatively wide range of ac voltages and dc motor loads. Hence, with a constant generator field, ac line voltage variations are not reflected in the dc output.

Most mining generators are compound wound, the degree of compounding being adjustable. Usual practice is to adjust the series field for flat compounding (constant voltage) up to rated load. The voltage regulation beyond full load is approximately 7%, as shown in Fig. 3. Adjustment of the degree of compounding provides means of obtaining satisfactory parallel operation with other power conversion equipment.

The efficiency of a typical 275-v, 300-kw motor-generator set, presented in Fig. 4, reflects the windage, field, and friction losses inherent regardless of load.

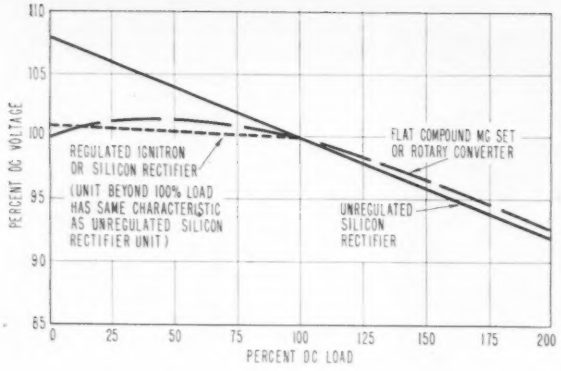


FIG. 3 VOLTAGE regulation curves for dc conversion equipment for 275-v mining service. Note that voltage regulation beyond full load is about 7%. (See text for comment on regulated vs unregulated silicon rectifiers.)

The motor-generator set will require maintenance attention to bearing temperature and lubrication, commutator, slip rings and brushes, winding insulation level, and set alignment. Some of the maintenance items will require periodic equipment shutdown.

Synchronous Rotary Converter

A synchronous converter incorporates the essential features of a synchronous motor and a dc generator, utilizing one armature common to both the motoring and generating functions. The energy enters the armature coils as ac through slip rings at one end and leaves as dc through brushes from a commutator at the opposite end. The field poles are similar in construction with those used in dc machines except that they are provided with additional windings and starting the converter as an induction motor. These windings, short-circuited grids placed in the faces of the field poles, serve also to stabilize normal operation. The main field coils are excited from the dc output through a field rheostat and serve as the field for the synchronous motor. A series field is provided to accomplish compounding.

As with the dc generator, the limiting factor on the overload capacity of the synchronous converter is its commutating ability. The overload capabilities of the converters match those of generators on motor-generator sets.

The dc voltage of the converter is directly related to the ac voltage applied to the slip rings. Any variation in the system ac voltage is reflected in the dc output voltage. Transformers are used to provide the ac voltage required for a given dc output voltage as well as to provide reduced voltage for starting.

The switchgear and control associated with a converter is similar to that used with a motor-generator set. A typical synchronous converter installation is shown in the foreground of Fig. 6.

The synchronous converter runs at a constant speed. Changing the field excitation affects the power factor but only to a small degree does it control the dc voltage. Converters are essentially unity power factor devices and if operated at a power factor less than 0.95 excessive heating will result. This places a limit on the degrees of dc voltage control obtainable through field control at approximately 5%. The regulation of a typical

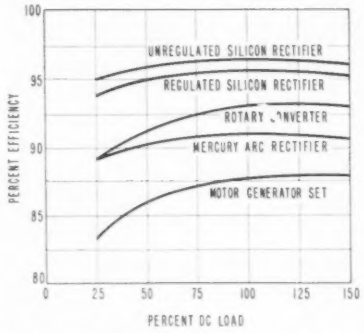


FIG. 4 TYPICAL EFFICIENCIES of dc conversion equipment for mining use.

synchronous converter is adjustable by varying the degree of compounding, and can be made sufficiently close to that of ignitron and silicon rectifiers to permit parallel operation. The regulation may also be adjusted as in Fig. 2 for flat compounding for operation with regulated supplies.

Having only one armature reduces the windage, friction, iron and copper losses from those of the motor-generator set. This makes the rotary converter more efficient as shown by the curve in Fig. 4. The maintenance requirements are similar to those of the m-g sets previously discussed.

Rectifier Assembly Arrangements

Rectifiers, as a source of dc for mining, differ from the motor-generator set in that the dc energy is not generated. Instead, like the rotary converter, a rectifier produces direct current by converting electrical energy already in ac form without first transforming it into mechanical energy. This is done by selective switching either of multiple units or separate portions of a common unit.

In all cases the rectifier units are employed singly or in series-parallel banks to match the voltage and current requirements of the dc load. The current carrying capacity in the low resistance—"forward"—direction establishes the number of parallel units required. The breakdown voltages in the "reverse" direction establishes the number of units which must be placed in series for a given application.

A single unit placed across a single phase ac supply will conduct current only when terminal 1 is positive, as shown in Fig. 5a. Hence, it will provide intermittent dc.

Four units placed in a single-phase bridge circuit permit dc current to flow for both directions of ac polarity and a steadier dc supply is obtained, as shown in Fig. 5b.

Three-phase ac power permits more elaborate arrangements of rectifier units which provide dc with greatly reduced pulses, or ripples. Figure 5c illustrates the circuit of such a multiphase rectifier. Still more elaborate rectifier arrangements are employed to achieve steadier dc voltage and more effective utilization of transformers, as shown in Figure 8.

Mercury Arc Rectifier

In mercury arc rectifiers, the switching units are electronic devices utilizing the arc which can be established and controlled in a space filled with mercury vapor. A cutaway view of such a unit—the ignitron tube—is shown in Figure 7. In operation, a cathode spot is formed by passing current from a starting ignitor into the mercury pool. This cathode spot releases high energy electrons which produce additional electrons from the mercury vapor within the steel envelope through a chain reaction. When the anode becomes positive relative to the cathode, conduction takes place between the mercury pool and the anode. Current will continue to flow until the anode voltage drops to a low value and the arc is extinguished. Starting, with the cathode spot, must be repeated each time the tube should conduct.

Circulating water around the tube serves to remove the heat generated during conduction and maintains the most desirable operating temperature and mercury vapor pressure. The water is then passed through a water-to-air heat exchanger.

To obtain the proper dc voltage, rectifiers are served by transformers with special windings and ratios. These transformers have their primary winding suitable for the ac power supply and the voltage of the secondary winding chosen to meet the requirements of the dc load. The transformer secondary windings are connected in a double wye single way circuit for mine ignitron applications, as shown in Fig. 8. This circuit gives the most economical design. A three-phase primary winding excites the two electrically displaced three-phase secondaries which have their mid-points connected by an interphase transformer. In each secondary, one tube conducts at a time except for a brief overlap period while the current is transferring from one tube to another.

The maximum dc voltage obtainable from the rectifier is determined by the transformer voltages. However, by delaying the time of the ignitor pulse, it is possible to reduce the dc voltage. This reduction in dc voltage is accompanied by a proportional reduction in the power factor and an increased ripple in the dc voltage. With greatly delayed firing, the ignitron tubes are more likely to arc back (lose their blocking action). As a consequence, the reduction of the dc voltage is limited in mining rectifiers to approxi-

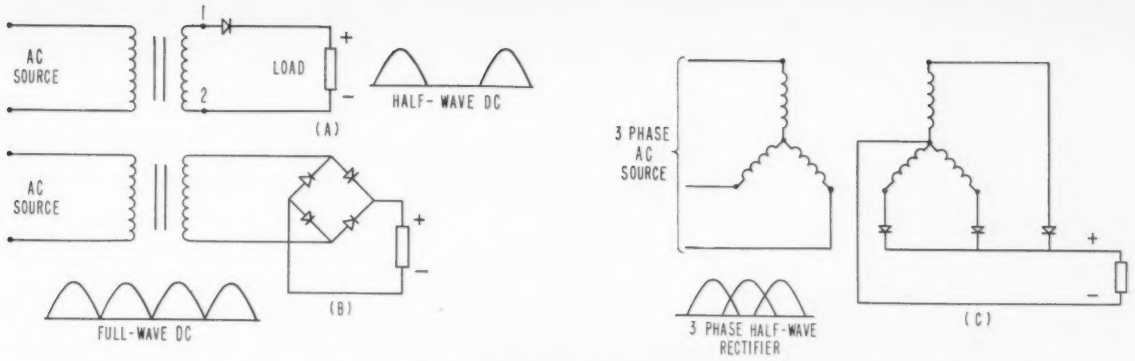


FIG. 5 (A) shows half-wave output of single rectifier in single-phase circuit; (B) four rectifiers on single-phase produce full-wave dc output; (C) three-phase rectifier hook-up yields steadier dc current for mining loads.

mately 15% of the unit's rated voltage.

Little additional equipment beyond basic firing circuit components is required for voltage regulation of an ignitron rectifier. As such, the voltage regulator for an ignitron rectifier represents a small percentage of the total equipment and cost. It is so designed that at 100% load on the rectifier, ignitor pulses are occurring without delay. Any increase in load beyond this point results in approximately 7% regulation as shown in the curve of Fig. 3. Satisfactory parallel operation with other conversion equipment is achieved by adjustment of the voltage regulating equipment. Note that with the constant ignitor firing angle, the dc voltage will reflect any change in the system ac voltage.

Ac and dc switchgear is necessary to protect the rectifier during faulty operation of one of the ignitron tubes which places a short circuit on the transformer. Such infrequent faults are due to loss of vacuum, high operating temperature, or exhausted tube life (average tube life, about 7 yr). To limit the magnitude of the short circuit current, transformers are designed with high reactance. Any units operating in parallel with a faulted rectifier will contribute to the fault current, hence the need for the dc switchgear.

The ignitron is essentially a static device requiring only two small auxiliary motors. Therefore, the losses of the rectifier consist primarily of transformer losses—iron and copper—and arc losses, the last two largely proportional to load. The arc loss is the product of the arc voltage (approximately 16 volts) and the load current. The resulting efficiency of the ignitron rectifier is illustrated in Fig. 4.

The power factor of an ignitron rectifier at full load is approximately 94%, as shown by Fig. 2. As the load is reduced, the firing angle is retarded to maintain constant dc voltage. This retardation of the firing angle has a further adverse effect on the power factor in proportion to the angle of delay.

Unlike the motor-generator set and the rotary converter, the overload capacity of the ignitron is determined by the heat absorbing capacity of the ignitron tubes. Consequently, the momentary capability of the ignitron rectifier is somewhat greater than that of either the motor-generator set or rotary converter.

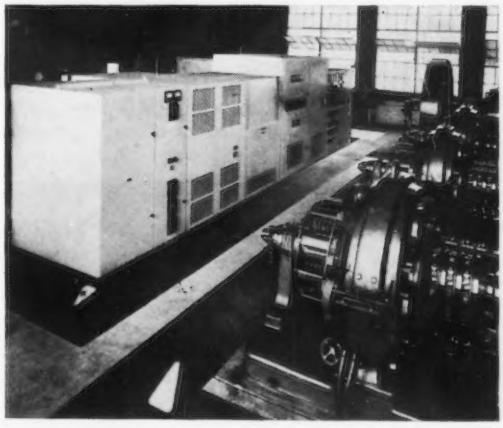


FIG. 6 TYPICAL synchronous converter installation. Switchgear and controls are similar to those used with an M-G set.

A complete portable ignitron for mining service is shown in Fig. 9. It is assembled on three cars, the ac switchgear car, the transformer car, and the rectifier and dc switchgear car. The ac car contains the incoming circuit breaker, metering equipment and the auxiliary control transformer. The power transformer is either the dry air-cooled type or Inerteen filled. Two ±2½% taps are provided on the transformer primary for adjustment to various ac line voltages. The third car contains the ignitron tubes and firing circuit components along with the heat exchanger and control equipment. The rectifier is completely protected and operation is semiautomatic or unattended. All apparatus is completely enclosed and affords maximum protection for personnel.

Practice of established maintenance programs has proved the ignitron rectifier to be a very reliable device. However, due to somewhat complex circuitry, a relatively high level of maintenance skill is required to minimize down time and insure proper operation of protective devices. In addition, any water cooling system requires constant vigilance to maintain in top operating efficiency.

Semiconductor Rectifiers

Increased knowledge about a group of materials with unique electrical properties has led to rectifiers referred to as dry type, solid state, or semiconductor type. These materials have conductivity poorer than copper and aluminum yet better than insulating materials. Also their electrical resistance decreases with temperature. Another identifying characteristic is the large degree to which the electrical properties of semiconductors vary with their crystalline structure, impurity content, and method of preparation. Semiconductor materials when assembled with good conductors in a laminated wafer-like unit offer low resistance to current flow in one direction and extremely high resistance in the opposite direction. This characteristic permits the unit to serve as a one way valve to current flow and sets up its use in dc and ac circuits to produce direct current. The operational "key" lies in the microscopically thin layer of barrier material formed between the semiconductor and the conventional conductor. The manufacture of these semiconductor rectifiers is an elaborate process requiring careful quality control. Procedures vary with the semiconductor material which in the present state of the art can be either copper oxide, selenium, germanium, or silicon. The comparative characteristics of these materials is presented in Table 1.

Copper Oxide and Selenium

Copper oxide rectifier units consist of a plate of pure copper, one surface of which has been oxidized under controlled conditions to form cuprous oxide. This

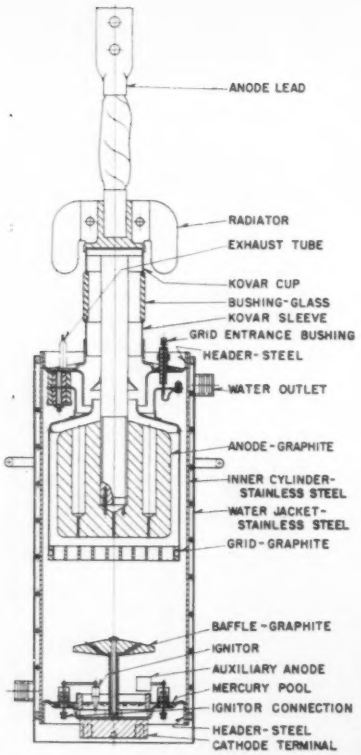
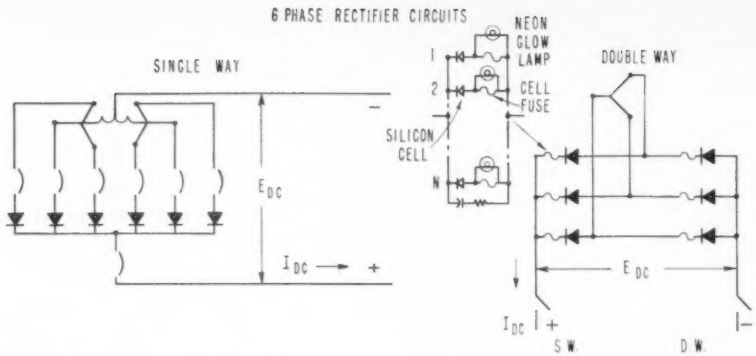


FIG. 7 CROSS-SECTION of ignitron mercury-arc power rectification tube.



		S.W.	D.W.
RECTIFIER ELEMENT	AVE CURRENT	$.167\,I_{DC}$	$.33\,I_{DC}$
RECTIFIER ELEMENT	PEAK CURRENT	$.5\,I_{DC}$	$1.01\,I_{DC}$
RECTIFIER ELEMENT	PEAK INVERSE VOLTAGE	$2.09\,E_{DC}$	$1.05\,E_{DC}$
TRANSF. TERMINAL	RMS CURRENT	$.289\,I_{DC}$	$.817\,I_{DC}$
TRANSF. SECONDARY	RMS VOLTS LINE TO NEUTRAL	$.855\,E_{DC}$	$.428\,E_{DC}$
TRANSF. SECONDARY	KVA	1.48 EI	1.05 EI

FIG. 8 SIX-PHASE rectifier circuit produces steadier dc voltage. Transformer use is more effective. See text for comment on reason for fuse arrangement.

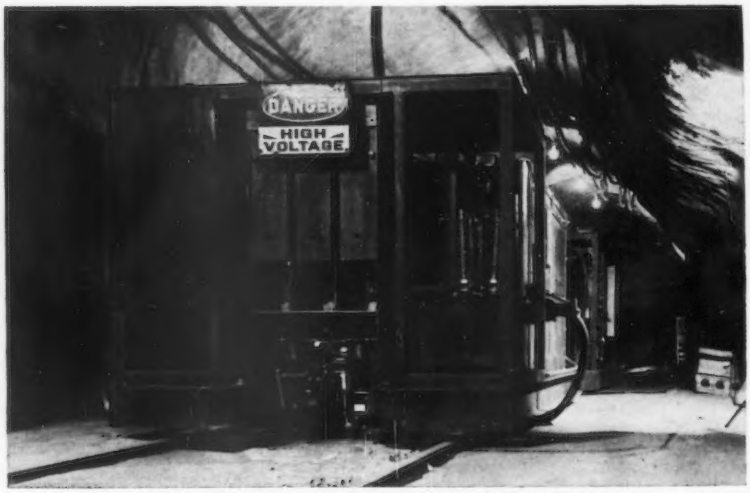


FIG. 9 PORTABLE IGNITRON for mining is assembled on three cars; one for ac switchgear, one for transformers, and one for rectifier and dc switchgear.

is assembled with the oxidized side next to another plate of good conductivity. The rectifying action takes place in the molecular border between the pure copper and the cuprous oxide, current passing readily from oxide to copper but with difficulty from copper to oxide.

Such rectifier units have been stacked in parallel and series to serve applications up to 100 kw and 500 amp. The losses are related to current flow with a fixed voltage drop across the rectifier cell. Hence they operate most efficiently near their rated voltage and this consideration, together with thermal capacity, establishes a practical limitation for their use.

Selenium rectifiers consist of a layer of selenium plated on a metal support disk and covered by metal alloy. The metal alloy constitutes the required good conductor, the selenium the poor conductor. The barrier layer is created electrically after the disk has been assembled.

The units conduct current readily from selenium to the alloy but offer a high resistance in the opposite direction and can be employed as one way valves in rectifier circuits. These units are smaller and lighter than the copper oxide rectifiers. They are preferably operated in an ambient of 35°C but can successfully withstand temperatures up to 130° for short periods of time. The resistance to current flow in the forward direction increases with age. This results in a decrease in efficiency significant only if the resistance of the rectifier is high with respect to that of the connected load. Advancing semiconductor technology has caused the obsolescence of copper oxide and selenium rectifiers as principal sources of dc power.

Germanium

Crystalline germanium is the rectifying element from which these units derive their name. The germanium is mounted between two molybdenum plates. It is soldered to one with tin and to the other with indium. During the manufacturing process, the indium diffuses into the germanium to form the barrier junction. The entire assembly is mounted in an evacuated tube with a copper base and pigtail at the top serving as terminals. Provision is made for air or water cooling of the base.

Germanium units have extremely low resistance in the conducting direction and high resistance in the inverse direction as long as the unit is operated below 65°C. Moisture and other impurities impede cell performance which explains the need for sealed construction. Above 65°C the inverse resistance decreases rapidly. This characteristic has led to germanium being superseded by silicon in semiconductor rectifiers.

Silicon

Silicon is the most recently developed semiconductor for rectifier use. A disk of silicon with minute traces of impurity is assembled between an aluminum plate and high temperature solder. This "sandwich" is fused at a high temperature to form the rectifying junction between the aluminum and the silicon. The units are sealed to prevent contamination. A cross section of such a cell is shown in Fig. 10.

Silicon rectifier units retain their high inverse resistance at higher temperatures than any other rectifier units yet developed. They have been made with peak

Table I—A Very General Comparison of Selenium, Copper Oxire, Germanium, and Silicon Components

	Copper oxide	Selenium	Germanium	Silicon
Size	Large	Large	Very small	Very small
Weight	Heavy	Light	Very light	Very light
Cooling	Natural or forced	Natural or forced	Natural or forced	Natural or forced
Life	Long-proven	60,000-100,000 hr (convection-cooled ratings)	Very long	Very long
Aging (forward resistance)	Stabilizes	Increases	None	None
Forward loss at same current density	Good	Fair (highest)	Excellent (lowest)	Good
Leakage (reverse current)	Fair	Good	Excellent	Excellent
Series operation of cells	Excellent	Excellent	Good	Good
Parallel operation of cells	Excellent	Excellent	Good	Good
Cell-operating temperature limit	75° C.	150° C.	85° C.	250° C.
Thermal capacity	Best	Fair	Poor to good	Poor

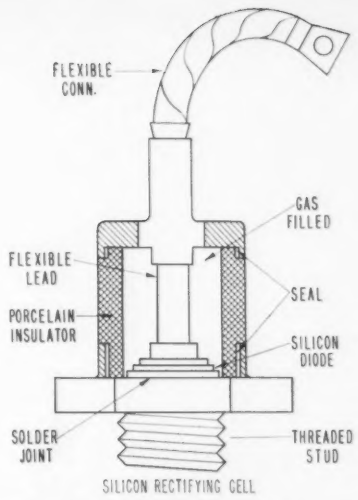


FIG. 10 SILICON RECTIFIER cross-section shows silicon diode wafer.

inverse voltage rating up to 1000 v. These characteristics permit smaller, lighter and more efficient equipment with greater margin for momentary overload conditions. Silicon units are thus established as the logical ones for the mining industry.

A typical leg of a 3-phase bridge is shown in Fig. 8. Notice that only 1 cell is connected in series with a fuse in each of the 6 legs of the bridge assembly. The breakdown or peak inverse voltage—PIV—limits the voltage across which semiconductor cells may be applied. A margin of 2.5-3 is maintained between PIV classification of the cell and the rectifier rated dc voltage. Multiple cells are used in series to obtain the desired PIV margin in applications above 300 v dc. A series resistor and capacitor network is connected across each leg of the bridge to reduce the transient voltages which may appear.

Average cell current is governed largely by the application. In mining applications a diode with a nominal current rating of 147 amp is applied to carry an average current of approximately 40 amp reflecting the severe operating conditions encountered. Fourteen cells are connected in parallel in each of the 6 legs for a 500-kw, 275-v rectifier and 20 are connected in parallel for 750-kw rectifier.

There are two common methods employed to cause paralleled silicon cells to divide the load equally. One method consists of classifying the cells according to their forward drop and operating only like cells in parallel. This method necessitates stocking of various classification of cells and replacement with the proper type. The second and most desirable method consists of a unique arrangement of magnetic coils through which the bus connecting the silicon cells are threaded as shown in Fig. 11. If one cell should try to carry less current than its proper share, an aiding voltage is induced in its connecting lead until current balance is again restored.

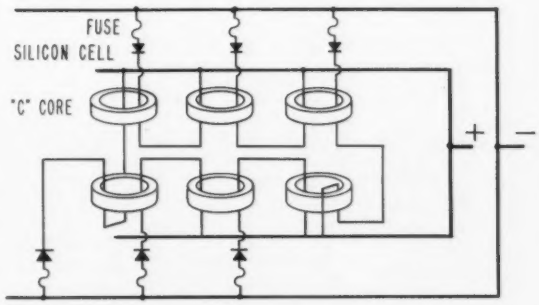


FIG. 11 UNIQUE arrangement of magnetic coils is designed to equalize the current load carried by the silicon cells. See text.

When conducting current, heat is generated at the cell junction. This heat must be removed to maintain a safe operating temperature. A heat sink as shown in Fig. 12 accomplishes this. The cell is mounted in a copper or aluminum block of metal equipped with fins to conduct heat away from the cell and dissipate it in the cooling air stream. In mining applications, approximately 2000 cmf of room ventilation at 20°C are required for proper cooling of a 500-kw silicon rectifier.

The safe current carrying capacity of the silicon cells is shown in Fig. 13. The silicon cell has a very high short-time carrying capacity, but due to the small mass, it cannot carry these currents for an extended period of time without overheating. To limit the cell current to a safe value, current limiting-type fuses are connected in series with each cell. These fuses operate only upon a cell failure and allow continued operation of the remaining cells without interruption of the primary circuit. A neon glow lamp is connected across each fuse to indicate such a failure. While it is expected that a defective cell will be replaced during an early nonproductive period, full load current may safely be carried even with one failed cell in each of the six legs of the bridge.

Silicon cell failure does not constitute a short circuit on the dc bus. This prevents other power conversion apparatus operating in parallel with the rectifier from pumping back through the defective unit resulting in a system shutdown. Protection against dc overcurrent is afforded by means of a dc contactor in the standard arrangement. Automatic load measuring is provided by apparatus located in the rectifier car.

Silicon semiconductor rectifiers for surface and underground application are shown in Fig. 14. A conventionally connected 3-phase power transformer is used. It is either air or Inerteen insulated, self-cooled for underground operations, and air, Inerteen or oil insulated, self-cooled for surface operation. A single-phase auxiliary transformer, located on the transformer car, supplies the control switchgear and space heaters. The control and metering apparatus is similar to that of the ignitron rectifier.

The inherent voltage regulation of the silicon rectifier, like the ignitron, is approximately 7%, as shown in Fig. 3. Hence it is a relatively easy matter to operate unregulated silicon rectifiers, ignitron rectifiers and rotary converters in parallel. Unlike the ignitron rectifier, however, the silicon has no inherent means of regulating the dc voltage. Adjustments in the dc voltage must be made by changing the ac voltage. This is effectively done by inserting controlled variable reactance in the circuit. Such an all-static regulating scheme usually produces a 10% voltage

FIG. 12 HEAT SINK carries away heat generated in silicon rectifier cell.

control range. "Trinsistors," three-element control silicon rectifiers, offer future possibilities for regulating dc voltage in much the same manner employed on ignitrons. However, any method of regulating the voltage of silicon rectifiers requires additional expensive equipment, approximately $10 per kw for the controlled reactance scheme. Careful analysis will usually reveal that it is more economical to employ unregulated silicon rectifiers.

The unregulated silicon rectifier has approximately the same transformer reactance as the ignitron rectifier and hence approximately the same full load power factor. At lighter loads the silicon rectifier has a higher power factor than the ignitron due to the absence of phase control always present with the ignitron type. To obtain output voltage regulation, additional reactance is introduced in the silicon rectifier circuit resulting in the power factor as shown by the silicon rectifier curve in Fig. 2.

The silicon bridge rectifier is approximately 96% efficient, as shown by Fig. 4. This high efficiency is the result of the lower arc drop of the silicon cell (approximately 1 v as compared to 16 v for the ignitron); approximately 35% lower transformer losses than equivalent ignitron transformer and lower auxiliary power requirements.

The significance of the high efficiency of the silicon rectifier is evident when it is considered that based on 4000 hours of operation at 50% load and a power cost of one cent per kwh, a 500-kw silicon rectifier will result in $600 annual savings in power cost as compared to the ignitron rectifier.

Operating experience with silicon rectifiers shows a cell failure rate of less than 1% per year. For a 500-kw, 275-v rectifier utilizing 84 silicon cells, this would mean less than one cell failure per year and these would not cause any interruption in service. Assuming 6 cell failures during a seven-year period, the replacement parts cost would be $1250. During this same period of time, it would be necessary to replace all the tubes of an ignitron rectifier at a total cost of $4450, a difference of $3200 in favor of the silicon rectifier.

Simple circuitry makes the silicon rectifier an easy device to maintain, requiring no special skills beyond that required for ordinary industrial control equipment. Air cooling has removed any electrolysis problem associated with water cooled systems.

In addition to the cost saving factors above, the simplification of construction and manufacture permit a first cost of silicon rectifiers 20-40% below that of the ignitron type.

Application Suggestions

Underground Mining

A predominant characteristic of mining loads is that they consist of a series of sharp peaks of current superimposed on a rather low base current. The power conversion equipment must be able to handle these peak loads without exceeding their rating. Although it has been shown that these peak loads are not directly proportional to connected horsepower it has been found that for a 6-ft seam of coal, the demand factor per conventional mining unit is approximately 80% of the connected horsepower while it is only approximately 45% of the connected horsepower in a 3-ft seam. When two or more mining units are connected to the same dc source a further diversity factor should be used. It has been found satisfactory to employ the following factors for combined loads:

Two section loads	85%
Three section load	75%
Four section loads	67%
Five section loads	60%

It has also been established that the most economical kw rating of the conversion equipment for conventional mining is either 500 or 750 kw. Therefore, the required rectifying capacity should be purchased in units of not less than 500 kw.

Conversion equipment for haulage loads should be capable of 200% overloads to allow for accelerating requirements. Due to the nature of the track and trolley system unregulated units are ideal for this application. If the face and haulage loads are connected, the haulage requirements should be added directly to the face requirements without a diversity factor for heavily worked haulage systems. For moderately worked haulage systems, a diversity factor of 0.5 may be suitable.

Fig. 3 shows the voltage characteristics of unregulated and regulated silicon rectifiers. Notice that the regulator does not raise the voltage at full load but only decreases the voltage at light load. This is an inherent factor in all voltage regulated rectifiers and should be considered when comparing regulated versus unregulated power supplies. One can deduce that if the load voltage of the unregulated unit is not damaging to the equipment there is nothing to be gained by regulating the voltage.

The maximum dc voltage of a 275-v unregulated silicon unit is 294 v at no load. The rectifier has 19 v regulation and, allowing 50 v for the distribution system, provides a motor terminal voltage of 225 v.

Many excellent articles have been written concerning mine power distribution

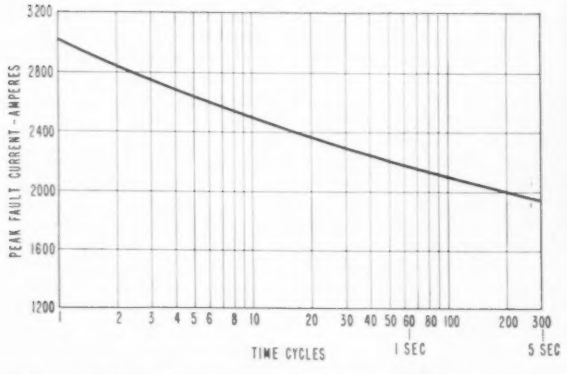


FIG. 13 SAFE CURRENT-CARRYING capacity of silicon cells is maintained with current limiting fuse for each cell.

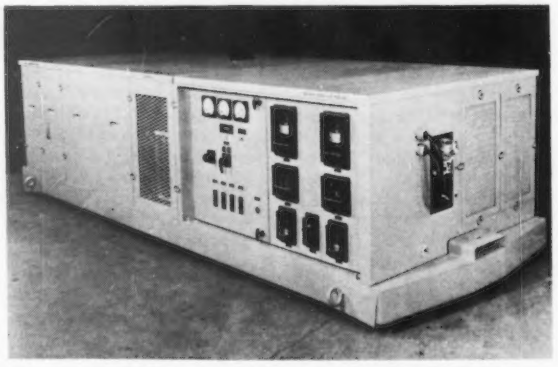


FIG. 14 SILICON SEMI-CONDUCTOR RECTIFIER for use in surface and underground mining applications.

systems and it is generally agreed that the systems should be designed for a maximum line voltage drop of 50 v. Transmission efficiency demands that the power conversion equipment be maintained close to the load. In many cases this factor dictates that portable underground units be employed because of the depth of the seam or ore body or the inaccessibility of right-of-way on the surface above the mining area.

Equipment to operate underground should be designed to operate in an extremely dusty atmosphere and should be equipped with filters to keep this dust from places where it may cause trouble. Also the equipment should be provided with heaters to control condensation of moisture under light or no load conditions. Older rotating-type equipment is especially subject to dust accumulation and must be periodically cleaned to prevent damage to winding insulation. Modern mining rectifiers are designed to operate under such conditions and require little additional maintenance. Portability of equipment is important since the time required to move units is often vital to the maintenance of production schedules.

The air required to cool a conversion unit is proportional to its losses. Supplying this air can be of major importance to a mine where ventilation is already a serious problem. Therefore, the highly efficient silicon rectifier requiring the least amount of air possesses a definite advantage.

If the equipment is to be operated above ground, provision should be made to properly protect it from the weather. Heaters are often required during the winter to maintain suitable operating temperature for mercury arc rectifiers and fans are usually employed in the summer to remove the heat from the enclosure. Access to the equipment location must be maintained in all seasons to enable authorized personnel to perform regular inspection and maintenance. Consideration of the aforementioned factors recommends the silicon rectifier for mining operations. Not only does it meet all the application requirements, but in addition it will provide substantial savings in initial and operating cost over its nearest rival, the ignitron rectifier.

Open Pit Mining

The major need for direct current at an open pit mine is a constant potential power supply—500 v—for the mine haulage system. Alternating current is available at 4.16 or 13.2 kv, 3 phase, 60 cycles. The load varies widely, increasing as locomotives pass the substation and reducing as they move to more remote sections of the rail system. With no trains passing for extended periods, efficiency at light load becomes extremely important. The semiportable trolley system in close proximity with mining equipment on the benches produces occasional short circuits.

The traction system is permanent from the mill to the pit mouth and can be supplied from equipment located in permanent substations. These are constructed to be free from excessive moisture and moderately free of dirt. Ventilation can restrain the ambient to that encountered outdoors at the site.

That portion of the traction system located in the pit is subject to constant relocation, yet is sufficiently remote from the substations that excessive voltage drop will reduce locomotive effectiveness. Portable ac to dc substations are therefore needed in the pit.

Silicon rectifiers are preferred for this service. They offer the desired high efficiency at light loads and the minimum in cost of substation construction. The rectifiers can be mounted on a railroad car chasis and be readily moved about the pit as required.

Mineral Beneficiating

In concentrating plants the major need for dc power is to provide excitation for synchronous motors driving ball or rod mills and for the fields of magnetic separators. Synchronous motors may run in size from 200 to 2500 hp and require 3 to 15 kw of excitation each. This represents a sizeable power requirement in large plants with 30 or more such drives. The operations are usually arranged for parallel groups of moving equipment, each group having an excitation source. Such a group may consist of 2 ball mills and 1 rod mill and a few separators.

These devices require continuous constant potential excitation usually in the 125- or 250-v range. Power is available at 440-v, 3-phase, 60-cycles ac. A single source—25 to 150 kw, can supply the bus, and individual resistors are then used to adjust the excitation of each device. Dirt or dust, frequently magnetic, and generally abrasive, is always present in the mill and in many cases moisture as well. Thus where possible the dc supply should be located in a separate, clean, ventilated room. If not, maximum protection coincident with adequate ventilation should be provided. The ease of mounting and maintenance makes static type silicon rectifiers outstanding for this application. Generally the load will be quite constant and the inherent voltage regulation should suffice. If the number of units to be excited varies greatly, the voltage may vary sufficiently to warrant inclusion of a regulator. Variable reactance devices placed in the rectifier transformer circuit serve this purpose.

Smelting and Refining

Ac power failures are becoming increasingly remote with improved generation and distribution techniques. However, the damage which can result to converters and ladles should the copper set in them can be very costly both in equipment, replacement and production time. It is thus imperative that a sure source of power be available to keep the air going to the converters until they can be emptied and the metal placed in the holding furnace or otherwise disposed of depending upon its degree of processing.

To do this, the converter drive motor, converter blowers, and cranes serving the converter aisle are supplied from a special constant potential 250-v dc bus. This bus is supplied by a motor-generator set equipped with a flywheel. Such motor-generator sets range in rating from 100- to several hundred kw. At least one standby is required to serve during periods of maintenance or repair to one of the sets.

Atmospheric conditions at a smelter are unfavorable to electrical equipment. Dirt, heat and moisture predominate in exposed locations. For this reason the auxiliary flywheel motor-generator sets are located in a separate room with filtered air taken from outside the mill. Under such conditions, the motor-generator sets serve with a minimum of maintenance in this extremely important duty.

In the refinery, the principal energy requirement is in dc form. It is the only form suitable for transferring metal electrochemically from anodes of "pure" metal to cathodes of extremely pure consistency. Cadmium, copper, lead, tin and zinc are a few of the metals processed in this manner. The transfer current will vary with the metal and electrolyte and the area of anodes employed. The voltage likewise varies with the process. Broad range of requirements are 15 to 25 amp per sq ft of cathode and 0.2 to 0.6 v per cell of 25 to 35 anodes. Power supplies range from 500 to 6000 kw and voltages 125 to 600 v.

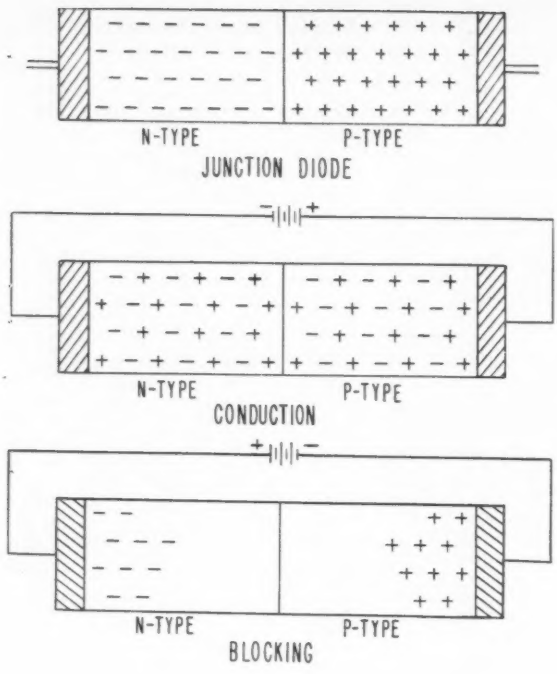
Variations in plant loading, cell maintenance and recharging make it necessary to operate with a different number of cells in series hence a broad range of voltage adjustment is required. This can become as great as 3 to 1 in some plants. Thus, it is evident the power source must offer high efficiency over a wide load and voltage range. The atmospheric conditions are usually free of dirt but contain corrosive fumes from the electrolyte. For this reason, the power supply equipment is usually located in a separate room with controlled ventilation. Problems of power distribution dictate locating this room adjacent to the cell area.

Adjustable voltage silicon rectifiers offer the greatest advantages as a power source. They are easily installed, have no exposed operating parts to be attacked by fumes, offer the best efficiency over the load and voltage range required and are the lowest in first cost. Such advantages are resulting in their use on new applications in place of motor-generator sets formerly employed.

Semiconductor Rectifiers

Silicon, one of the most popular elements used in the manufacture of semiconductor devices, will be the example used in presenting the theory of operation of semiconductor rectifiers. Silicon is a hard and stable element in its crystalline form, with four electrons in its outer orbit. It is the electrons in the outer orbit (valence electrons) which determine the electrical characteristics of materials. A crystal of pure silicon comprises millions of atoms each tied to four other atoms by virtue of sharing outer electrons. This sharing of outer electrons constitutes an electron bond which is a strong tie between the many atoms of the crystal.

The structure of a silicon crystal is such that there are no free charges to move about upon the application of an electric field. If enough energy is added to an atom of the crystal, some electron will acquire sufficient energy to break the bond and become free electrons available



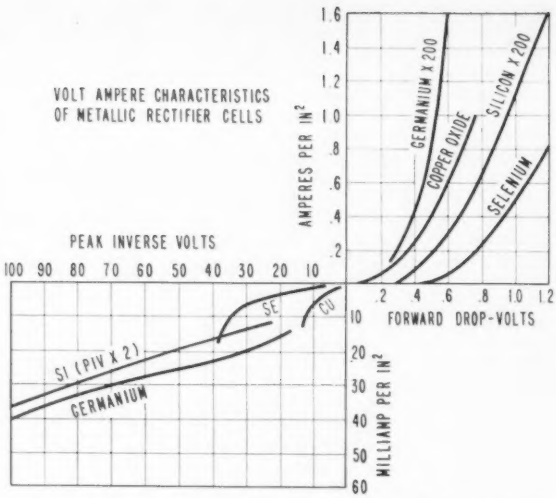


FIG. B CURVES SHOW typical voltage-current characteristics for silicon and other types of semiconductor cells.

FIG. A (Left) HOW RECTIFYING action is produced in a junction of positive (P) and negative-type (N) elements.

for conduction. Upon escape, an electron creates a hole or vacant spot. This hole will untimately be filled by another electron, but it too must have created a hole when it becomes free of its original electron bond. Thus, it is apparent that holes and free electrons are created simultaneously and in equal numbers. However, it is necessary to be able to create holes or free electrons independently to form a rectifier of this material. By doping—the process of adding certain impurity atoms to the crystal structure of silicon—it is possible to gain free electrons or free holes independently. For example, the addition of an atom of arsenic with its five valence electrons to the silicon crystal results in a free electron in this structure without an accompanying hole. Therefore, there is an electron available for conduction and the number of such electrons can be controlled by regulating the amount of impurity added to the pure silicon. Such a doped material is termed N-type.

Likewise, an element such as boron could be used which has only three valence electrons. Instead of extra electrons as before, there would now be extra holes. In this case conduction is due to the movement of the holes. This material is known as P-type.

If the two materials are now joined, a P-N junction will have been formed as shown by the top drawing of Fig. A. The holes and electrons in the junction area combine to form ions or electrically charged atoms which in turn produce an electric barrier at the junction. This barrier is caused by some of the holes and electrons crossing the junction and bonding with the atoms in the region near the junction. The barrier developed is of such a polarity to prevent more holes and electrons from crossing the junction.

If a positive potential is now applied to the P material with respect to the N material, the barrier will be overcome and a large current conducted through the relatively low forward resistance of the conducting material as illustrated by the center drawing of Fig. A. However, if the applied potential is reversed, the barrier is strengthened and few electrons or holes will cross the junction.

Effects of Temperature

Those that do possess enough energy due to thermal agitation continue to cross the junction barrier and therefore this reverse current is never quite zero. Any increase in temperature will increase the number of holes or electrons able to cross the junction. As a result, the maximum junction temperature is governed by the reverse current allowable. Typical voltage-current characteristic curves for silicon and other semiconductor cells are shown by Fig. B.

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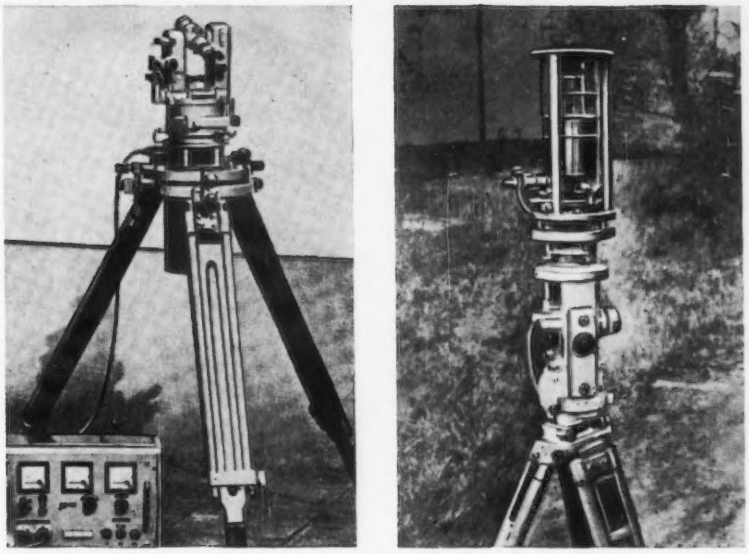

THE GYROTHEODOLITE is accurate, but for economy and portability, the theodolite-gyro (right) was developed as an accessory to fit any conventional theodolite.

Gyrotheodolite—Modern Tool for Mine Surveying

This article is abstracted from a paper entitled "Recent Application of the Gyrotheodolite in Tunnelling Work, in Underground Workings and in Applied Geophysics" by Prof. Dr. Otto Rellensmann. It was presented at the International Symposium on Mining Research, Rolla, Mo., Feb. 21 to 25, 1961.

Dr. Rellensmann is Professor of Mining, University of Clausthal, Clausthal-Zellerfeld, West Germany.

THE GYROTHEODOLITE, which accurately transmits meridian lines to underground workings, has perhaps its greatest potential as a geophysical reconnaissance instrument. A magnetic needle built into the unit can determine declination—difference between magnetic and true north—and abnormal declination values can give a clue to the presence of magnetic orebodies.

Ever since the gyro-compass, which senses the turning of the earth and points out true north, was introduced as a navigational instrument for ships and aircraft, efforts have been made to adapt the tool to mining and associated fields. Since 1947, the Mine-Surveying Institute, Mining-University, Clausthal, West Germany, has been busy developing sub-surface orientation instruments, and, during the three years from '56 to '59, experimented with, and perfected, the gyrotheodolite for tunnelling, and for running traverses above and underground. The latest model gyrotheodolite, K. T. 1, weighs 56.9 kg and consists of the instrument, a tripod, and generator and battery.

Here, according to Prof. Rellensmann, are some features of the gyrotheodolite that permit it to perform more efficiently and accurately than other surveying techniques:

1. Giving a true azimuth, independent of weather. This can be done at any time on the surface or underground—no celestial observation necessary.

2. Reducing the number of traverse stations. The possibility of offset error increases with the number of necessary traverse stations, and since the gyro-traverse stations are fewer, the accuracy is proportionately increased.

3. Locating new points by resection. With a gyrotheodolite, only two triangulation points are necessary—conventional methods need three points. Several resections with distances of about 3000 m have been plotted near Clausthal. The instrument's accuracy was ±10 sec, and the approximate offset variance was ±15 cm.

4. Determining magnetic declination. An accurate compass mounted on the theodolite pinpoints the difference between true and magnetic north and, since no triangulation is needed, surveys can more easily be carried out in difficult-to-negotiate terrain.

Last summer, nearly 60 points were plotted at 3-km intervals over a 25-km^2 area in the northwestern Harz region. From the data obtained, a precise isogone map (two-minute isogone interval) was prepared with an accuracy of ±45 sec. Several magnetic deposits were outlined and these will be investigated in more detail this summer.

5. Plumbing shafts. By using the theodolite, only one plumb line (instead of the normal double plumbing) is needed to carry the coordinates underground and give a backsight for sub-surface traversing.

According to one report (Bergvermessungstechnische Blatter, December 1960, pp 89-95), 400 surface and underground sightings were established by the meridian indicator MW 4a in the Ruhr coal district during 1959 and 1960. In each case, the sightings' middle error amounted to only ±10 sec.

6. Driving tunnels with accuracy. During 1959, a 1000-m tunnel was driven 30 m beneath the Rhine River to join shafts at opposite banks. A gyrotheodolite traverse was used with lines measuring 50 m and, when it broke through, the tunnel was only 120 mm off-course.

Both the standard MW 4a meridian indicator and the K.T. 1 gyrotheodolite became exceptionally accurate. However, in order to save power consumption, cut initial costs, and make the units more practical, their weight and size had to be reduced—and all this without sacrificing any accuracy. These considerations, Dr. Rellensmann said, led to the development of the TK-1 and TK-2 theodolite-gyros. Both were light (TK-1 weighed 4 kg and TK-2 weighed 1 kg), and the idea was to build the gyro-instrument as an accessory which could be attached to any conventional theodolite. Though the accuracy of the new units could not compare with the original larger instruments, Dr. Rellensmann felt that this would be regained through further research.

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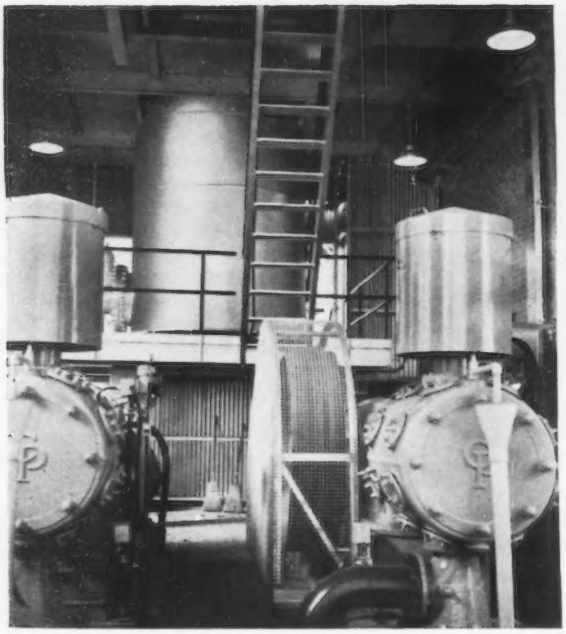
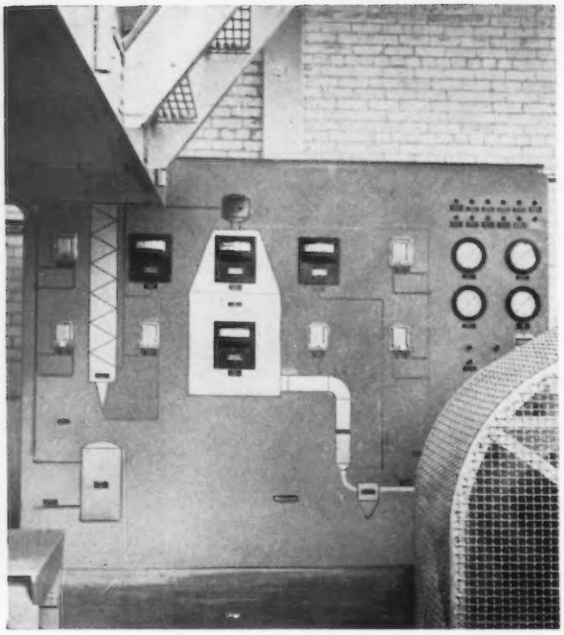


REFORMER (center) is key to process that eliminates old step of poling in copper refining. This is at Ajo, Ariz., smelter.



NOBODY has to man automatic gas-reformer plant. Either this board, at reformer, or one at anode furnace controls it.

"Poling" Becomes Ancient History At Phelps Dodge Smelters

JOHN B. HUTTL

USE OF RE-FORMED NATURAL GAS in place of green poles during the reduction step is a significant advance in the art of copper refining. It became an accomplished fact when a natural-gas-air reformer, with ample capacity for large-scale plant experimentation, was installed at the reduction works of Phelps Dodge Corp., Douglas, Ariz., in 1958.

With this unit, experiments were started in the gaseous reduction of oxygen-containing molten copper for the production of anode-quality refined copper in two gas-heated rotary 13x20-ft furnaces. The satisfactory results obtained subsequently led to the construction and installation of a larger reformer of 1000 cfm capacity, which incorporated in its design additional auxiliary equipment, operational refinements, and instrumentation with a view toward making pushbutton operation of the plant possible. Later, two additional plants were built, each with a capacity of 1500 cfm, for installation at the Ajo and Morenci smelters.

E&MJ was privileged to see the Ajo installation early in March, 1961, and a description of the plant layout and operations carried out there may be of interest. Company officials who were responsible for evolving the process are C. R. Kuzell, member of Board of Directors; M. G. Fowler, superintendent, Douglas Reduction Works; John H. Davis, Jr., chief mechanical engineer, Western Engineering Department; and Leonard Klein, research chemist.

Mr. Klein delivered a paper at the AIME meeting at St. Louis in February of this year describing the gas reforming process at the Douglas smelter. The Douglas process described by Mr. Klein is basically the same as that at Ajo, described here.[1]

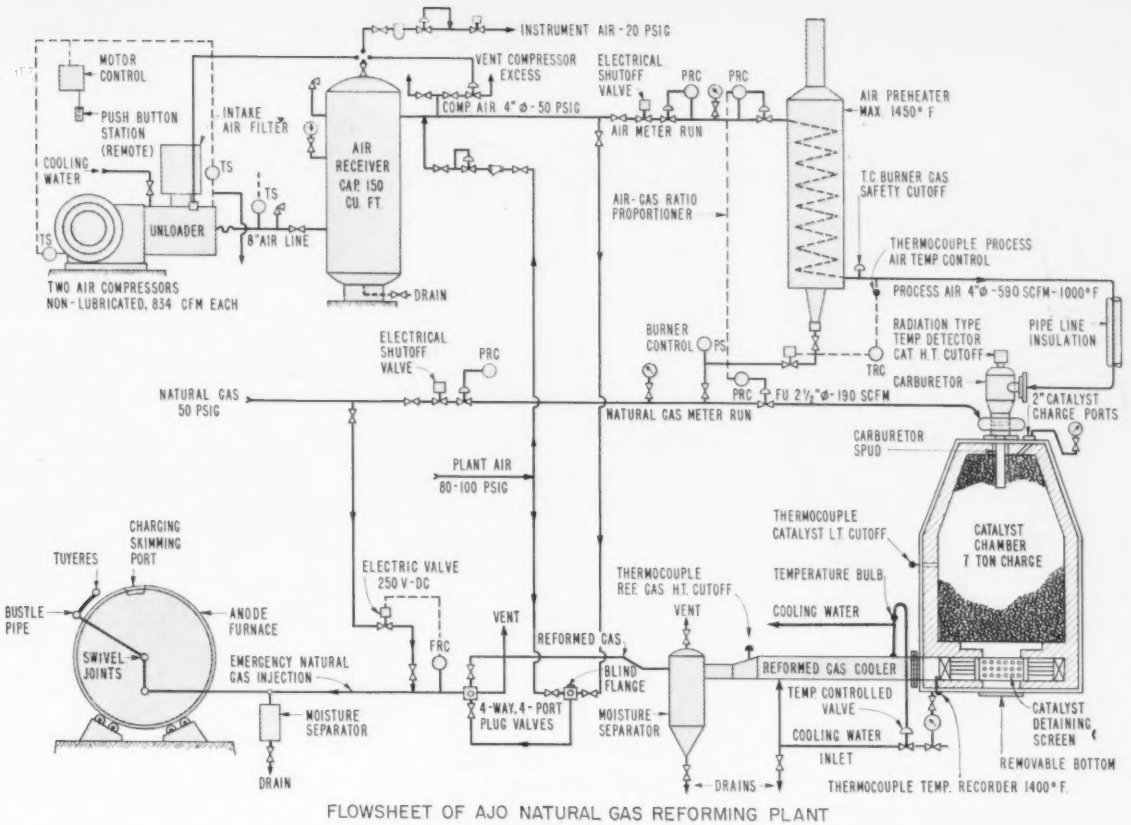
The gas reforming plant in operation at Ajo uses air to partially oxidize the carbon in methane to produce a gas consisting principally of CO, H_2, and N_2. This type of plant was chosen over one employing steam as a reformer because of the high nitrogen content of the gas produced. The nitrogen content of the gas has been found beneficial in copper refining by virtue of its sweeping effect. (Editor's note: for a discussion of gas reforming, see E&MJ December 1960, p 98.)

The natural gas available to smelters operating in southwest U.S., supplied by El Paso Natural Gas Co., consists generally of CH_4 (methane), CO_2, and N_2, with small amounts of higher homologues of CH_4 up to pentane, C_5H_{12}. An average analysis, with percentages by volume, is as follows: CO_2, 0.16%; N_2, 2.79%; O_2, 0.01%; CH_4, 86.01%; C_2H_6, 8.60%; C_3H_8, 1.95%; C_4H_{10}, 0.29%; and C_5H_{12}, 0.19%. The methane predominates; and because H_2S is absent, inclusion of sulphur-removing equipment in the plant flowsheet was found unnecessary.

The analysis by volume of the gas produced by the plant is approximately: CO_2, 1.6%; CO, 17.1%; H_2, 31.3% H_2O, 2.9%; CH_4, 1.2%; and N_2, 45.9%. The CO and H_2 are excellent reducing agents, and as such they replace the hydrocarbons normally introduced as poles. When this type of gas is passed into a molten bath of oxidized copper the reducing effect is potent and quite rapid.

Unreformed gas, on the other hand, will pass almost unchanged through the molten charge and burn on top of the bath and at the furnace ports with

[1] "Gaseous Reduction of Oxygen-Containing Copper." Leonard Klein, Research Chemist, Phelps-Dodge Corp. Douglas, Ariz., delivered at AIME convention, St. Louis, Mo., Feb. 27, 1961.



FLOWSHEET OF AJO NATURAL GAS REFORMING PLANT

NATURAL GAS is "reformed" to give carbon monoxide and hydrogen, active reducing agents, in series of apparatus shown here.

the characteristic luminous flame. The overall reducing effect is small, and the small amount of copper-oxide reduction that does occur may be credited to the higher homologues of methane. Methane itself remains chemically unchanged even after passage through the molten bath.

Consider natural gas simply as methane for purpose of explanation. Then the basic or ideal reforming reaction (excluding negligibly small amounts of CO_2, H_2O, and CH_4) called for thermodynamically in the final equilibrium mixture should be expressed as follows:

$$CH_4 + 0.5\ O_2 + 1.88\ N_2 \rightarrow CO + 2\ H_2 + 1.88\ N_2$$

$$\text{Air-}CH_4\ \text{Ratio} = 2.38$$

However, air-reforming of natural gas is more complex than expressed in this simple equation. The theoretical air-gas ratio for complete reforming of natural gas approaches 2.70, and in order to compensate in the plant for sensible heat losses, it has been found practical to use an air-gas ratio between 2.85 and 3.00 and to preheat the air.

The Ajo gas-reforming plant, which occupies an area of only 22x80 ft and has a height of 34 ft, is a short distance from the anode-furnace plant. Principal equipment components include a compressor (with one stand-by unit); air pre-heater; air-gas-ratio proportionator; integrated control apparatus; carburetor; reactor or catalyst chamber; heat exchanger (reformed gas cooler); gas-water separator; and emergency natural-gas injection equipment at the anode furnace.

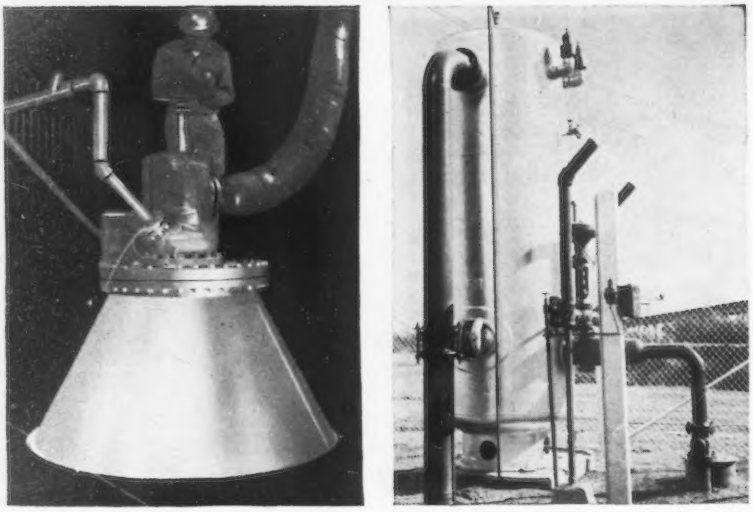
The compressor installation is arranged for dual use. A pipe line is available in the distributing system by means of which the reactor vessel may be bypassed and the total compressor output diverted to the anode furnace for oxidizing and/or skimming the charge. In the event of compressor failure, air required for plant operations can be obtained through a pressure-reducing valve from a branch line connected to the high-pressure powerhouse air line. Control equipment on the air-receiver tank serving the compressor and the powerhouse air line maintains a constant air pressure of 50 psig. The plant proper can be operated by pushbutton controls from the main control panel in the plant itself or from the control panel at the anode furnace. No operator is required at the plant at any time.

The natural gas reforming process operates as follows: Compressed air at a pressure of 50 psig, either from the compressor or from the high-pressure powerhouse air line, is preheated to about 1000° F in a gas-fired air preheater. Then it is directed to the carburetor, where it meets and mixes with room-temperature, 50-psig natural gas. Next follows treatment in the reactor vessel, which contains irregularly shaped lumps of alundum (90% Al_2O_3), from ⅝ to 1½ in. in dia and containing about 6½% nickel as catalyst. Then the reformed gas is shock-cooled in a cooler or heat exchanger, using water as coolant, and finally treated in the separator unit for removal of moisture. To see the plant layout and how it operates, look at the flowsheet above.

Below is a short description of the principal plant components.

Air Compressor. This is a nonlubricated unit with a capacity of 834 cfm free air, driven by a 125-hp electric motor. It is equipped with carbon piston rings. A second unit installed serves as a stand-by. The receiver serving both compressors has a capacity of 150 cu ft.

Air Preheater. The primary and secondary finned fire-tube-type heaters (each 32 ft long) are connected for



A KEY UNIT, is carburetor (left) atop reactor vessel. Compressed air for reforming reaction is kept at 50 psig in receiver tank (right) adjacent to reformer.

countercurrent flow, so that the air leaves the hottest part of the heaters. The heaters are horizontal and parallel, and are fired with natural gas.

Carburetor. This device, for which a patent is pending, is one of the most important units serving the plant. It resembles a small cyclone, into which the air is introduced tangentially near the top of the cylindrical section, while room-temperature natural gas enters through holes in the manifold encircling the carburetor near the bottom. The intimate air-gas mixture, as ejected from the carburetor outlet port, is caused to impinge without backfiring and with the least possible delay on the catalytic mass in the reactor vessel below. Improper mixing and/or defective introduction of the heated air-gas mixture must be avoided; these may cause backfiring, with possible damage to equipment, or adversely affect the reforming action, with consequent formation of a large amount of free carbon. The complete carburetor is made from stainless steel, and as designed permits continuous treatment of a wide range of air-gas mixtures and flows.

Reactor or Catalyst Chamber. This unit is a refractory- and insulation-lined vertical cylinder with an inverted cone section at the top. It is completely filled with the catalyst material described above, a full charge weighing about seven tons. The outlet of the chamber consists of a stainless-steel screen surrounded by a slotted brick wall. Reformed gas passes out through the screen and wall into a circular gas duct, and thence through the wall of the chamber directly into the cooler or heat exchanger.

On its initial run, the reactor is brought into operation from room-temperature condition by passing a small flow of slightly preheated air through the catalytic mass, gradually increasing the volume and preheating it until it reaches a temperature of about 1200° F. Next, the air is augmented with natural gas in roughly a 3:1 ratio and the mixture passed into the catalyst chamber, where the catalytic reaction initiates itself quickly and quietly. Although somewhat in excess of the normal ratio, the ratio indicated is maintained until the finished reformed gas has reached the desired temperature, after which the normal air-gas ratio is applied.

If properly insulated, a reactor, once it has been placed in operation, may be stopped and restarted without difficulty at any time thereafter, even up to three days. In the event of a slight drop in the activity of the catalyst, which occurs at times, caused by deposition of a very fine coating of free carbon, normal conditions can be restored by raising the air-gas ratio a little and slackening off on air preheating. This causes a rise in the catalyst temperature and burns off the carbon coating. This requires from 30 minutes to 1 hr. After such an operation, improved reformed gas may be detected by means of the conventional Orsat analysis. The reaction chamber is 7 ft. 7¾ in.- o.d. and 13 ft. 9-in. high over-all.

Cooler or Heat Exchanger. This is about 20 ft long and consists of 85 0.920-in.-i.d. stainless-steel tubes inside a water-filled stainless-steel tube of about 16-in.-dia. The gases received from the reactor at a temperature of about 1400° F are cooled down to 150° F in a matter of seconds. This shock-cooling is necessary to reduce the time in the temperature range in which side reactions produce elemental carbon. The cooler requires about 85 gpm of water. Cooled gas passes through a cyclone-type gas-water separator, for removal of water formed during the reaction, before being directed to the anode-furnace plant.

Principal reasons for incorporating an air-gas proportionator in the metering system are (1) to insure continuous automatic operation of the reformer flow controls, and (2) to give maximum protection of the catalyst at all times. Its function is to interlock the air and gas flow control instruments. The device is activated primarily by the gas flow control instrument, which in turn activates the air flowmeter. When the reformer plant is being started, natural gas starts flowing first, followed closely by the air. Soon after the gas flow attains its preset volume, the air flow reaches its preset total volume, dictated by the desired air-gas ratio. During operating periods the proportionator maintains the required air-gas ratio, regardless of the usual minor variations in gas and air pressures. When plant operations cease, both gas and air flows return simultaneously and almost instantly to zero. Positive closure valves preceding both air and gas meter runs prevent any leakage of air into the catalyst chamber during operation shutdowns.

Protective System

At the anode-furnace plant, a unique arrangement has been devised to protect fully-submerged furnace tuyeres in the event of sudden air- or gas-flow failures. In normal operation of the furnace, as soon as the tuyeres have been submerged, the operator flips the "Natural Gas Manual Cutoff" switch on the furnace control panel to "On" position, thereby activating a 250-v-dc electric valve in the natural-gas line leading to the furnace meter run. If the volume of reformed gas or air in the furnace line at any time thereafter for any reason should drop to an abnormally low preset value, this valve opens, allowing high-pressure natural gas to enter the furnace line, blocking the flow of copper back into the tuyeres. When this has taken place, an electric horn sounds an alarm, and the furnace operators turn the furnace up to a safe position without delay. This precautionary procedure has been activated most frequently when the reformer plant has been automatically stopped for any reason.

To get a good idea of actual conditions that the plant operator works with, study table 1, above. It gives the actual meters and gages at the main control panel, and also shows what normal meter readings are, with high and low readings in some cases. You'll get a good idea of the physical conditions that exist at the Ajo reformer by studying this table.

Table 1—Ajo Gas-Reformer Plant

Actual readings of meters and gages at main control panel
Normal and abnormal conditions

Name Plate on Panel Board	Element Indicated or Controlled	Readings Low	Avg.	High
Process air flow controller	Air volume to preheaters		590 cfm	
Process air pressure controller	Air pressure to preheaters	35 psi	50 psi	
Natural-gas flow controller	Natural-gas volume to reformer carburetor		190 cfm	
Natural-gas pressure controller	Natural-gas pressure to reformer carburetor	35 psi	50 psi	
Process-air high-temp. cutoff	Preheated-air temp. to reformer carburetor		1000° F	1200° F
Process-air temp. controller	Preheated-air temp. to reformer carburetor		1000° F	1200° F
Catalyst high-temp. cutoff	Top of reformer, catalyst temperature		1000° F	1600° F
Catalyst low-temp. cutoff	Middle of reformer, catalyst temperature	600° F	1100° F	1500° F
Reformed-gas temp. recorder	Reformed-gas temp. at bottom of reformer catalyst		1400° F	1600° F
Reformed-gas high-temp. cutoff	Reformed-gas temperature at cooler exit		150° F	400° F
Process-air pressure	Air pressure to preheaters		50 psi	
Process-gas pressure	Gas pressure to reformer carburetor		50 psi	
Carburetor pressure	Reformed-gas pressure at reformer carburetor	10 psi	20 psi	30 psi
Reformer discharge pressure	Reformed-gas pressure at bottom of reformer catalyst chamber	7 psi	15 psi	25 psi

Plant Operation

As known, the copper refining process consists of two main steps: (1) oxidation, and (2) reduction. During the oxidation process, if required, plant compressed air is introduced to the anode furnace through a 4-way valve setup and through appropriate piping to the four tuyeres mounted on the furnace. When oxidation and/or skimming has been completed, the gas reformer plant is started, and the reformed gas is passed through the same 4-way valve setup and tuyeres.

In starting the reduction step of the refining cycle, the furnace operator starts the compressor at the gas reforming plant, if it is not already in operation. Waiting for a short time for the compressor to build up pressure in the air receiver, he next starts the reformer proper. The reformed gas flowing to the anode-furnace plant, after venting a short time to the atmosphere, is introduced through the tuyeres at about 8 psig, and the furnace is tilted to submerge the tuyeres in the conventional way.

If one or more tuyeres get plugged during the refining process, which would be indicated by a rise in gas pressure, then the tuyeres are rolled out of the bath and opened with a bar or drill, with the reformed gas being vented to the atmosphere.

After cleaning, which ordinarily takes only a very few minutes, the furnace is returned to blowing position. Plugging of tuyeres is quite erratic. Many charges are processed without any plugging, while others require attention one or more times. The indication to turn up the furnace is when gage pressure nears 25 lb.

Inside the furnace shell the tuyeres are somewhat similar to a standard 2-in.-dia ball-free converter tuyere. They are mounted in a removable panel section of the shell. The panel may be removed, the four-piece tuyere block (brick) around the tuyere replaced, and a new tuyere pipe grouted in place from outside the furnace. The tuyere head proper is a standard pipe tee. Inside the 2-in. tuyere pipe a 1½-in. removable tuyere pipe is placed. Air or gas enters through the branch of the tee. The end of the tee opposite the tuyere pipe is closed with a plug, which is removed when the tuyere is to be punched.

When the plant was designed, considerable thought was given to safeguards for the different plant units and auxiliaries. This is particularly important for the catalytic mass, which should be protected from extreme temperature conditions. Catalytic reaction will not initiate itself if the catalyst gets too cold between periods of operations. And if, during operation, temperature gets too high, the finely-divided, well-dispersed particles of nickel will melt, coalesce in small globules, and inhibit almost completely the catalytic effectiveness. In the latter event, the catalyst must be removed from the chamber and reimpregnated or replaced.

Heart of the plant control system is a central panel near the reactor unit. Here, signal lights are installed to indicate almost any interference with operations; and protective devices are available that will prevent the plant from being started up or will shut it down, if undesirable conditions of temperature or pressure exist or if any malfunctioning, electric or mechanical, of a treatment unit occurs.

The Ajo smelter is now producing about 200 tons of copper per day, which is refined and cast as one charge per day in a 13x30-ft rotary furnace. As 1050 scfm of reformed gas flow into the anode furnace, 200 tons of copper are reduced in about four hours, which is close to the time previously required to reduce with poles.

Costs for natural gas and electric power for reforming is about 8.08 cents per ton of copper. This in contrast to 64c for poles. This is a small fraction of the cost of poling formerly.

Operational advantages offered by the process include improved safety and housekeeping; elimination of storage space for poles in converter aisles; elimination of fire and explosion hazards and of handling of loads by converter cranes and pole-handling equipment; pushbutton control; and possible reduction of labor force. To date, there have been no accidents of any kind within the smelter attributable to gaseous refining.

LISTENING to opening talk by congress president C. S. McLean are (front row, l to r) South African I. S. Haggie and Canadians Dr. E. E. N. Smith and Dr. A. Smith.

S.A.'s Minister of Mines Sen. De Klerk chats with Finance Minister Dr. Douges.

Seventh Commonwealth Congress Details

MORE THAN A THOUSAND MINING MEN from all over the world attended the mammoth, month-long Seventh Commonwealth Mining and Metallurgical Congress. The Congress, which lasted from April 10 to May 20, included talks, papers, and excursions to the mining districts of South Africa, Northern Rhodesia and Southern Rhodesia.

Designed to give the visitor a thorough background into mining practice in southern Africa, the Congress emphasized the historical as well as the current role of mining in the area. The technical papers presented at the Congress also reflected this idea; they were long, detailed and well illustrated. Thus, the complete set of papers, although voluminous, offers a thorough, historical and up-to-date account of mining in southern Africa.

In one address in Johannesburg, Senator J. De Klerk, South Africa's Minister of Labor and Mines, presented an encouraging picture of future developments in the new republic's mining and metallurgical industries, which now produce about 62% of the world's gold. Senator De Klerk stressed these reasons for South Africa's continuing expansion: (1) a stable government; (2) large—and untapped—mineral resources; and (3) numerous financial concessions offered by the government to stimulate prospecting and exploitation.

JUST before the Inauguration—(l to r) Dr. R. Westwater, Mr. J. K. Shanklin, Dr. W. J. Busschau and Dr. J. Slatterly.

Remarking on the development of South Africa's mining industry since the founding of Johannesburg 75 years ago, Senator De Klerk stated: "We can boast of having the deepest underground workings in the world—11,000 ft; of having the world's greatest gold refinery where over 20-million oz are refined annually; of having a uranium industry with the world's largest ore reserves; of having some of the foremost diamond mines and the largest explosives factory in the world—not to mention the £100-million oil-from-coal plant at Sasolburg, and a £250-million expansion project by ISCOR (Iron and Steel and Steel Corp.) over the next 12 years. Here are some other facts: value of mineral production for 1960 — approximately £450-million; labor force in the gold mining industry for the same year—456,000."

To a mining man, several aspects of South African gold mining are noteworthy. For one thing, the mines are unusually deep, hot and wet. Thus, there are exceptional problems in ventilation, pumping and ground control. In comparison to other mining areas, development headings and mining equipment are generally small in size. Railroad haulage is the usual transportation system.

Development speed is of prime importance in South Africa, the philosophy being to get the mine into production as fast as possible even though the development cost may be higher than it would be at a slower speed. Note for example, the recent shaft-sinking and sustained tunnelling records made in the new republic.

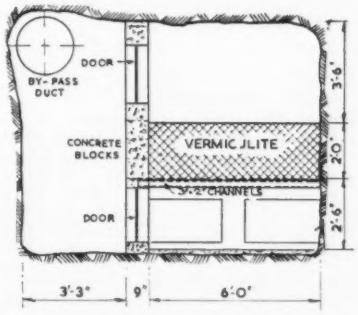
AT the Government Banquet—(l to r) P. Halse, Mr. and Mrs. McDermott, L. T. Campbell-Pitt and Miss E. Campbell-Pitt.

African Mining Practice

Scientific management (industrial engineering, as we know it) came into vogue in South Africa in the 1930's. The scientific studies resulted in ever increasing labor and equipment efficiencies. One early study, for example, resulted in a 100% increase in hand mucking productivity per miner. One over all result can be summed up by noting that tunnelling costs are about the same now as they were in 1922, despite a trebling in the cost of labor and supplies.

Concurrent with the emphasis on scientific management came an emphasis on mining engineering. That the typical South African mine today is well-engineered from headframe to sump is reflected in the technical papers. Parts of four of these papers are abstracted here because of their interest and usefulness. The first paper is by S. R. Rabson.

The fast elimination of blasting fumes, a long standing headache (in more ways than one) of miners, is possible with an extraction plant in which exfoliated vermiculite is impregnated with an alkaline solution of potassium permanganate. Such a plant is practical in mine areas where fast exhaust of blasting gases is neither practical nor economical, and it permits multi-shift blasting. The potassium permanganate absorbs the oxides of nitrogen, but has little effect on the oxides of carbon.



Since the development of the vermiculite fume extraction plant in South Africa, a number of plants have been put into commission for longer or shorter periods. During 1959 for example, some 15 plants were in operation in different mines at various periods, each handling from 8000 to 20,000 cfm.

A suitable design for a plant to extract nitrous fumes from blasting gases for multi-shift operation is illustrated in Fig. 1, which indicates the basic requirements.

The following points are to be noted in the installation and operation of a fume filter.

The size of the plant is based on the quantity of air required to be exhausted from the end to insure adequate clearing of the fumes. Estimate the area of the vermiculite bed on the basis of 50 cfm per sq ft of surface.

Use vermiculite graded between ⅛-in. and ⅜-in. mesh. The thickness of the bed should not be less than 2 ft. Estimate the quantity of vermiculite required on the basis of 250 cu ft per ton.

The resistance of the bed at 50 fpm can be taken as 2.5 in W.G. Support the bed on rails, I-beams or channel iron set across the width of the bed and spaced on 2-ft centers. Over this support lay a strong 1-in.-mesh wire screen, 10-gage, and then a finer but not too light screen; e.g., 16-mesh, 22-gage galvanized screen. Since the vermiculite absorbs 3 to 4 times its own weight of water, sufficient strength has to be insured in the supports.

The air should be arranged to pass downwards through the bed. In this way the decomposition of the chemicals proceeds from the top downwards and the reagent can effectively be renewed by spraying fresh solu-

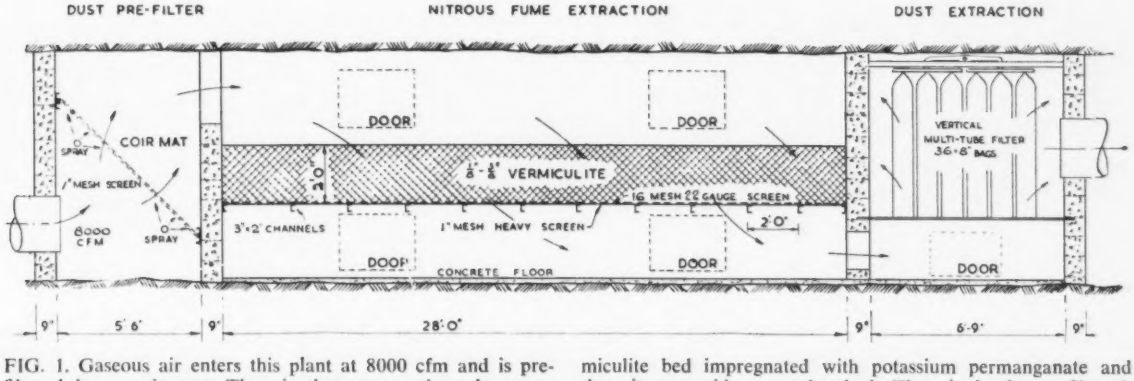


FIG. 1. Gaseous air enters this plant at 8000 cfm and is prefiltered by a coir mat. The air then passes through a vermiculite bed impregnated with potassium permanganate and the nitrous oxides are absorbed. The air is then refiltered.

Table 1. Extraction Plant Results

S. R. Rabson—An Extraction Plant to Eliminate Blasting Fumes.

Results of tests on trial fume extraction plant, Rand Leases (V) G.M. Co. Ltd.

Test No.	Time in Minutes	Inlet Samples %				Between Beds %				Outlet Samples %				Details
		NO	N_2O_3	NO_2/N_2O_4	Total	NO	N_2O_3	NO_2/N_2O_4	Total	NO	N_2O_3	NO_2/N_2O_4	Total	
2	1				.0130								.0005	Thickness of bed 12 in.
	2				.0614								.0086	Velocity 27 ft/min (800 c.f.m.)
	4				.0406								.0112	Extraction 79%.
3	1				.0355								.0044	Thickness of bed 12 in.
	2				.0728								.0145	Velocity 27 ft/min. (800 c.f.m.)
	4				.1140								.0397	Extraction 80%.
6	0-2	.0348	.0030	.0093	.0471	.0039	Nil	.0024	.0063	.0045	.0001	.0007	.0053	Thickness of bed 20 in.
	3-5	.0541	.0153	.0102	.0796	.0090	Nil	.0011	.0101	.0057	.0011	.0011	.0079	Velocity 20 ft/min. (600 c.f.m.)
	7-9	.0200	.0187	.0084	.0471	.0044	Nil	.0011	.0055	.0026	.0015	.0005	.0046	Two beds in series.
	14-16	—	—	—	—	.0016	Nil	.0010	.0026	.0010	.0005	.0010	.0024	First bed sprayed 2 days before test and both immediately before test. Extraction 1st bed 88.5% 2 beds 89.9%.
7	0-2	.0382	.0163	.0057	.0602	.0023	Nil	.0007	.0030	.0019	.0003	.0017	.0039	Thickness of bed 20 in.
	3-5	.0413	.0504	.0010	.0937	.0038	.0014	.0005	.0057	.0002	.0018	.0014	.0034	Velocity 20 ft/min. (600 c.f.m.)
	7-9	.0219	.0424	.0010	.0653	.0011	.0012	.0017	.0040	.0009	.0016	.0010	.0035	Two beds in series.
	14-16	.0093	.0214	.0010	.0317	.0012	.0006	.0014	.0032	—	—	—	.0030	Both beds previously sprayed and again 5 hours before blast. Extraction 1st bed 93.7% 2 beds 94.2%.
8	0-2	.0342	.0044	.0032	.0420	.0038	.0013	.0011	.0062	.0025	Nil	.0014	.0039	Thickness of bed 20 in.
	3-5	.0349	.0228	.0082	.0659	.0040	.0009	.0009	.0058	.0034	.0013	.0016	.0063	Velocity 40 ft/min (1200 c.f.m.)
	7-9	.0096	.0234	.0020	.0350	.0014	.0002	.0012	.0028	.0006	.0006	.0016	.0028	Two beds in series.
	14-16	.0045	.0049	.0010	.0104	Nil	.0005	.0011	.0016	Nil	Nil	.0018	.0018	First bed sprayed 2 days before test. 2nd bed sprayed 20 min before blast. Extraction 1st bed 86% 2 beds 90%.
9	0-2	.0216	.0031	.0010	.0257	.0023	Nil	.0014	.0037	.0014	.0002	.0010	.0026	Thickness of bed 20 in.
	3-5	.0204	.0242	.0065	.0511	.0087	.0020	.0010	.0117	0039	.0016	.0010	.0065	Velocity 55 ft/min. (1650 c.f.m.)
	7-9	±.007	—	—	(.007)	.0020	.0028	.0010	.0058	.0013	.0018	.0010	.0041	Two beds in series.
	14-16	.0039	.0053	.0010	.0102	.0011	.0012	.0010	.0033	.0003	.0006	.0010	.0019	Beds sprayed 48 hours before test. Extraction 1st bed 79% 2 beds 87%.
12	1				.0827								.0477	Thickness of bed 24 in.
	2				.0938								.0440	Velocity 47 ft/min. (1400 c.f.m.)
	4				.0786								.0216	Beds sprayed 18 days before test.
	8				.0445								.0141	Extraction 65%.
	15				.0165								.0051	

Explosive used in tests: 50 lb ammon dynamite 60% (Test 2 = 60 lb; Test 9 = 40 lb)
Reagent: 5% $KMnO_4$ + 5% Na_2CO_3

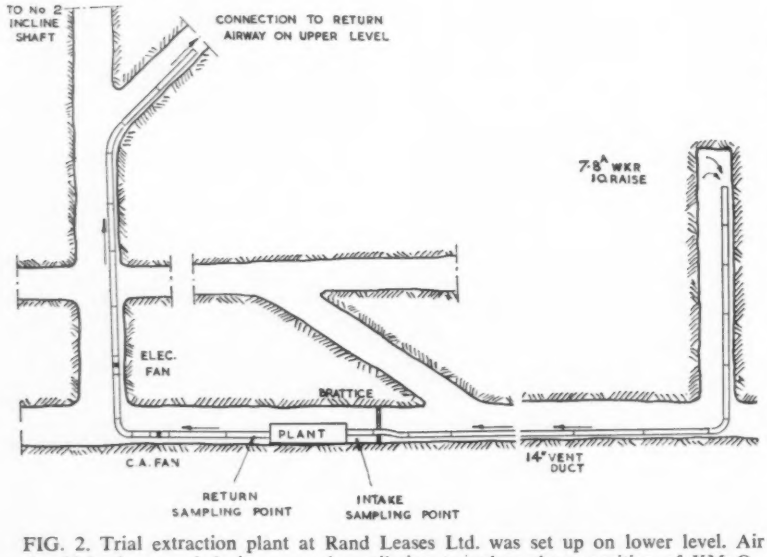


FIG. 2. Trial extraction plant at Rand Leases Ltd. was set up on lower level. Air should be by-passed during normal ventilation to reduce decomposition of $KMnO_4$.

tion over the surface. Also, the bed is less liable to channel during the blast if the flow is downwards than if it is upwards.

Arrange for spraying the solution on the bed manually by means of a hose-pipe supplied by a suitable pump. For this purpose access doors must be provided in the side wall above and below the bed. Fixed sprays are not successful due to clogging and incomplete coverage.

Supply suitable containers for preparing the reagent; e.g., 44-gal drums can be used, or a concrete sump can be made. Allow for approximately ½ gal of solution per sq ft of bed to be sprayed each time. For the initial impregnation, 3 to 4 times this amount is required.

The strength of solution is 5% soda ash (Na_2CO_3) and 5% potassium permanganate ($KMnO_4$); i.e., 50 lb of each chemical in 100 gallons water. Since the chemicals dissolve with some difficulty, it is suggested that the chemicals be added to the water a day or two before spraying and allowed to dissolve by continuous mixing with a trickle of compressed air.

The bed should be sprayed a few hours before use to allow it to drain. The highest absorbtion efficiency is obtained when the bed is in a semi-dry condition. In normal operation, the bed should be sprayed once a week.

No walking should be allowed on the bed.

Arrange ducting, fans and dampers so that the bed can be by-passed during normal ventilation of the end and only brought into circuit during blasting time. Arrange all controls to be accessible in fresh air. The fan should preferably be installed with the plant on the suction side so that leakage takes place inwards. Install a coir matting pre-filter with sprays in advance of the vermiculite bed. This will remove coarse dust and prevent clogging of the vermiculite. Install an efficient dust filter in series with the plant in order to eliminate blasting dust.

Allow the exhaust gases from the plant to mix with an adequate quantity of diluting air before reaching working places. This serves as a final dilution for the emerging fumes and is also necessary for the dilution of carbon monoxide concentration. The ratio of diluting air to treated air should not be less than 5 to 1.

Note: No timber should be used in the construction of the plant where it may come into contact with the permanganate since carbon monoxide will thereby by liberated.

Table 1 gives results of tests on a trial fume extraction plant at Rand Leases (V) G. M. Co. Ltd. which was set up as illustrated in Fig. 2.

S. C. Newman—Tunnelling Techniques in South African Gold Mines

The following outstanding advances recorded at Doornfontein by one crew in two ends, in successive measuring months of 26 working days are

noteworthy examples of sustained performance in tunneling: 1467 ft, 1567 ft, 1610 ft, 1673 ft, 2102 ft, and 2466 ft. During this period, the best advance recorded on 26 consecutive working days amounted to 2609 ft (equivalent to 21,500 tons). At Loraine Gold Mines in March 1960, an advance of 2695 ft was recorded in twin ends. The best point-to-point footage at Doornfontein was 1903 ft per month.

Mining equipment for a modern tunnelling operation in South Africa consists of six 2⅝-in. jackhammers, with six spares; six 2¹⁵⁄₁₆-in. airlegs, with five spares; round-hex tungsten carbide steel, 108 or 102 x 1-in.; one air-operated shovel loader, with one spare (size either 3 tons per minute or 1 ton per minute); locomotives, 3 to 5 or 6-ton, 30-hp (either diesel or battery, the cost of the former being much less); one drill carriage with collapsible side flaps; one manifold car equipped with ring mains and 7 valves each for air and water machine connections and with racks for drill steel; hopper traverses (a type of switch), of which 3 are in use at any one time; hoppers (cars), eighteen 4-ton or twelve 6-ton.

Tunnel equipment consists of permanent rails (60 lb per yd); temporary track (45 lb per yd); air column, 6-in. (permanent); water column, 4-in. (permanent); air column, 2-in. (temporary); water blast, 2-in.; exhaust column, 30-in. (ventilation) and booster column, 16-in. (ventilation) and compressed air fan.

The European crew consists of one mine overseer (part time), one shift boss per shift, one developer per shift, one helper per shift, one construction track layer per 24 hours, one general construction worker, one fitter, part-time surveyor, part-time electrician. Native labor consists of developing (15 per shift, including locomotive drivers), construction (10 per shift), general construction (10 per day), engineering (4 per day), and supervision (5 per day). Where very high rates of advance are anticipated, the use of 4 crews is advisable, and complements should be revised accordingly.

The anticipated cycle organization is (1) round drilled, 32 holes x 8-ft, drag-type; (2) pilot holes, 4 x 12-ft, one in each corner of the face; (3) standard advance per blast, 7½-ft; (4) standard advance per 24 hr, 51.4-ft; (5) traverse bays 80 ft apart; and (5) diamond-drill bays, 300 to 400 ft apart.

Standard cycle times are (1) drill and blast, 1¼-hr (including charging up); (2) clean, 1¾-hr (including water down and make safe); (3) re-entry, ½-hr; (4) total, 3½-hr; (5) rounds per 24 hr, 6.9; and (6) advance per 26 shifts, 1336 ft.

The following are regarded as the major factors that have enabled the very high rates of advance in South Africa:

1. The length of round has been reduced to 8 ft; thus reducing the rock broken to an optimum for 2 rounds to be completed in 6 hours, with the equipment at present in use.

2. Air pressures have been substantially increased, with the result that drilling and cleaning times have been materially reduced.

3. The introduction of and the marked improvement in the performance of shovel loaders, with loading rates twice those of scraper slides.

4. The use of tungsten carbide tipped steel, enabling penetration speeds to be raised to 12-in. per minute and with the subsidiary benefit of a considerable decrease in the quantity of steels handled.

5. The use of airlegs, jackhammers and light mobile drill carriages, instead of the heavy 3½-in. machines and rigged bars, which contributed to excessive fatigue and required considerably longer rigging time than spotting time for airlegs.

6. The improvements in car changing, the time being reduced from several minutes to one minute, due to the introduction of the light, easily handled traverser.

7. The use of ventilation columns instead of brattice walls which could never have been erected at rates to keep pace with the face advance.

These are then the measurable material factors. Two, however, are of very great importance, but are not measurable:

A. The enormous improvement in general organization, resulting from the excellent training given to all crew members, both European and Native, and the consequent increase in efficiency in terms of useful work done.

B. The very high morale in modern high speed crews fostered by careful attention to organization, to detail, to the wants of the members and to the fostering of good team spirit, and materially assisted by the payment of substantial bonuses for good performance.

With the different costing systems employed, it is difficult exactly to determine direct costs of developments, but for modern multi-blast work, it may be accepted that total costs of £10 to £15 per ft ($28.00 to $42.09) will be incurred, these including direct charges for consumable stores, all European and Native wages, indirect charges for hoisting, air and electricity supply, and installation of permanent equipment, on a basis of 60-lb track and 12-in. air main. Compared with a figure of £13 per ft in 1922, and considering that explosives efficiency has fallen from 5-7 ft/case to 2-2½ ft/case, these costs may be considered as extremely satisfactory, in view of the rise in prices that has occurred between 1922 and 1959. Stores and equipment form about 60% of the total cost, wages 29% and the costs of both these items have at least trebled since 1922.

W. J. Ross—Pumping Slimes

For the purposes of this abstract the following general definitions of slime and sand are used:

Slime—A rock product which has been ground to contain particles of not more than 5% plus 300 micron size, nor less than 50% minus 75 miron size and which includes all fine material produced by the comminution process. This has been mixed with varying proportions of water and in this slimes state is capable of being transported (pumped) through pipelines.

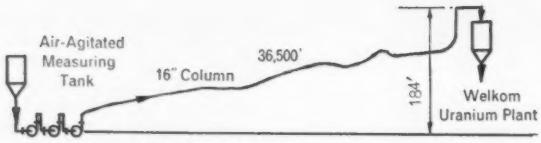
Sand—A product which has been ground to contain particles of not more than 15% plus 300 micron size and which excludes impermeable slime produced by the comminution process. This has been mixed with varying proportions of water and in this state is capable of being transported (pumped) through pipelines.

The apparent viscosity of solid-fluids as mixtures is greater than that for water alone, but, in the following, this fact can be neglected because mixture flow must be well into the turbulent stage in which pipe friction is little affected by viscosity.

Friction losses in a liquid-solid flow are not necessarily greater (at the same velocity) than for water only; further, the presence of suspended material within the pipe adds to the turbulence and probably breaks up the laminar sub-layer attached to the pipe wall.

The term critical is used in the sense that it refers to a transition stage between any pair of alternatives in fluid flow. There are actually two minimum critical velocities and both are of the utmost importance. These are such that: (1) The critical velocity at which the loss of head (in ft of mixture) begins to differ appreciably from that particular loss of head (in ft of water only), if both these were to flow in the same pipe at the same velocity; (2) The critical velocity at which a tendency to choke occurs, due to the settling-out of the particles.

In a 9-in.-dia, 30,000-ft pipeline from President Steyn Gold Mining Co.



ELEVATION

FIG. 3. Pipeline from Freddies Consolidated Mines Ltd. (South) to Welkom Gold Mining Co. Ltd. is typical of those in Orange Free State Joint Production Scheme.

Pumps	Motors	Av. running time/day	Aver. S.G.	Vel. f/s	Dry solids T/mth.
Three–10 in × 8 in SS., RL. C pumps in series	Three–150 h.p. 980 r.p.m.	9 hrs. (Batch pumping)	1.46	3.96	120,000

Pump Speeds: 1st stage, 920 r.p.m.
2nd stage, 980 r.p.m.
3rd stage, 980 r.p.m.
Delivery press. at pumps: 260 psi.

Table 2. Pipeline Data and Costs

	Freddies N Freddies S	Freddies S Welkom
Data		
Route (feet)	26,700	36,500
Diff. in elevn.	+88	+136
Max. static head	+136	+184
Duty (T solids/mth.)	60,000	120,000
Design:		
Pipe bore (ins.)	12 in	16 in
Thkns. (G or ins.)	3/16 in	3/16 in
Aver. vel. (ft/sec)	3.78	3.96
Capacity (T/mth.)	176,000	249,000
% running time	34	48
Joints (Fl=flanged)	Fl.	Fl.
B=line buried	B	B
Gradient (degrees)	3°	3°
Total head (ft slimes)	260	320
Static head (ft)	+88	+136
Friction head (ft)	172	184
Pumps (C=centrif.)	C	C
Slimes h.p.	112	275
No. and size of pumps	Three–8 in in series	Three–8 in in series
Capital Cost, £'s	82,000	136,000
£/ton duty	1.37	1.13
£/ton cap.	0.46	0.55
£/ton mile duty	0.27	0.16
£/ton mile cap.	0.0925	0.079
Running Cost:		
d ton	6.33	6.33
d/ton mile	0.547	0.547

Ltd. to Welkom Gold Mining Co. Ltd., choking tendencies occurred when the average velocity of flow reached 3.2 fps with slimes having a SG of 1.48 and with a liquid/solid radio of 1 to 1.

Tendency-to-choke velocity can be described as being that velocity at which the surface layers of the settled particles are caused, not actually to flow in suspension, but rather to begin to roll along the bottom of the pipe and exhibit characteristics similar to those of a plastic. Thus, flow of very small suspended particles can occur below the turbulent range. Sand on the other hand, does not remain in suspension below the turbulent range. In general, however, the transportation of liquid-solid mixtures in pipelines is usually confined to the turbulent region of flow and there is also a certain higher and critical velocity which must be maintained if efficient and economic transportation is to be achieved.

There is reason to believe that the strength of turbulent fluid components is a function of the ability of the flow to transmit suspended solids. In other words, flow capacity within the pipe to carry suspended material is a function of the strength of the fluctuating components of an average velocity parallel to the axis of the pipe. The shape of the path lines in turbulent flow is varying continuously and any individual water particle does not move along a fixed path. It can have a definite mean value for velocity in both magnitude and direction, provided large time intervals are considered. Actually it is for this reason that a pipe (within which flow conditions are turbulent) can deliver a steady flow.

In the Welkom area of the Orange Free State Province, a joint pumping scheme was established to transport residual slimes from various gold mines. In this system, five pipelines connect six properties. One of these, from Freddies Consolidated Mines Ltd. (South) to Welkom Gold Mining Co. Ltd, is detailed in Fig. 3 and in Table 2.

Gland water is supplied by a centrifugal pump at a pressure of 300 psi, and the quantity regulated to each stage gland service to approximately 20 psi above the pump pressure. The gland pressure can be boosted to plus or minus 380 psi in the event of a blockage occuring in the column.

The line was buried some 18 to 20 in. underground.

The specific gravity of the slimes transported in this line (as in most of the others), is subjected to variations. It is delivered to the treatment plant at a SG of 1.46, and to allow for dilution by gland water service, it is fed to the pumps at about 1.51. Taking an average throughout, a SG value of about 1.46 is obtained, on which basis the L/S (liquid-solid) ratio is 1 to 1.

From operating experience with this pump column, the SG of slimes should not be less than 1.35 if particle settlement and hence choking is to be avoided. If a choke due to this cause does occur on this line (and such is most unusual), the SG of the slimes is increased to about 1.58 and a clearance is effected almost immediately, possibly due to the rolling, abrasive action of the introduced higher SG solids.

The best average velocity has been shown to be, by test, 3.96 fps, when the SG of the slimes is 1.46, and the line is operating under uniform conditions throughout its entire length. (By best velocity is meant that minimum velocity which will move the mixture through the line most efficiently). In this pipe, 3.96 fps is at or near the lowest possible for transportation of the material with minimum settlement of particles, and this has insured minimum friction losses.

In the design of this particular pipeline to carry solids in water suspension, use was made of the well-

WHY IT COSTS LESS TO OWN A CAT GRADER

Most motor graders *look* pretty much alike, no matter who makes them. They handle similar jobs, too, and it isn't always easy to *see* any big difference in the way they handle them. In fact, the manufacturer's suggested prices usually are not greatly different for machines of nearly equal specifications—regardless of the "deal" that may be offered a buyer. But *used* motor graders vary considerably in price. Why?

The Buyer Determines Price

A used machine is priced at what the buyer is willing to pay . . . it's a measure of what *he* thinks is left in a machine. So, with used equipment, the buyer sets the price. This is clearly demonstrated at used equipment auctions. A check of auction prices throughout the country shows, for example, that the Cat No. 12 Motor Grader brings substantially higher prices than comparable machines of other makes—as much as 80% more. (Only machines of the same age, same condition and with similar attachments were compared.) What makes a Cat Motor Grader more desirable than other makes?

A Feature That Affects Cost

Any machine is desirable if it is known to be dependable. This reputation can only be the result of true quality design and quality construction. The Cat oil clutch is a good example. It was designed and is built to give long, trouble-free life. But, how well does it do it? Let's examine the records of just one Caterpillar Dealer who has 161 oil clutch-equipped motor graders in his territory. His records show that in four years he has sold only $24.38 worth of parts for motor grader oil clutches! One machine in his territory went 2524 service meter hours without any work on the clutch. Many users report 2000 hours of service before the first adjustment. In 1000 hours of operation only about .0025 inch of wear can be expected—less than the thickness of a human hair. And, since all parts are constantly bathed in oil there is no need for lubrication maintenance. Less wear, less attention mean not only lower total repair costs but more time on the job . . . less down time. Of course, the oil clutch is just one example of many quality features in Cat Graders.

A Look at Total Cost Records

The cost records of private owners and governmental bodies show which machines cost less. For example, an Indiana county keeps individual cost records on their six motor graders, 14 trucks, three loaders and five tractors. Their records showed that a year-old No. 12 needed only a set of head gaskets and two spark plugs with $25 labor, while two newer graders of another make needed major engine repairs, new clutches and side shift linkage. One town in New Hampshire reports that in over 20,000 hours, their No. 12 has never had a breakdown that held up work more than three hours. Operating costs—24¢ per hour exclusive of fuel, oil and operator. Comparing a Cat No. 12 to another make (after 3½ years' service), the records of an Arkansas county showed a saving of $2478.57 in parts and labor for their No. 12.

What's in It for You

Others have proved that Cat Motor Graders cost less in the long run because they are built better in the beginning. Your Caterpillar Dealer has additional facts and figures on low-cost operation of Cat Graders in your area. Ask him for free Cost Record Books so that you can keep individual machine records on your equipment. Prove to yourself that it costs less to own a Cat Grader.

Caterpillar Tractor Co.,
General Offices, Peoria, Ill., U. S. A.

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known Weisback formula, and, as can be shown for slimes pumping, this does not differ radically from the form used when water only is the medium. That used was, for the 16-in. line:

$H_f = .000375\ LV^2$

Where H_f = Loss of head(ft) due to friction.

L=Length (ft)

V=Velocity (fps)

Corrections made under operating conditions of the line showed that the use of .000375 gave an over-estimated value for the larger sized pipes and was modified to, and found to be in agreement with:

$H_f = .00028\ LV^2$

In conjunction with this formula, due allowance (±10%) was made for pump wear, frequency variation, and such items as dilution of slimes by gland water and other items.

Other proved values for loss of head (in ft of water) due to pipe friction, were determined by Low and quoted in page 360 of the March 1957 issue of the SOUTH AFRICAN MECHANICAL ENGINEER. These are:

Head loss, H_f (ft of water)

For 6-in. pipes .001 LV^2

For 9-in. pipes .0005 LV^2

For 12-in. pipes .00037 LV^2

For 16-in. pipes .00028 LV^2

If the friction factor, f, be known, equivalent results can be obtained from a reading of the pressure drop over any given length. In such case, as compared with water:

Pressure drop (slimes) = Pressure drop (water only) × Average SG of mixture; the assumption being that the velocity within the line is greater than the critical.

Settling velocity can be determined from the formula

$$V(W_1 - W) \quad k \frac{AW\ v^2}{2g}$$

Where

V=Volume

W_1=Wt. per unit volume of solid

W=Wt. per unit volume of liquid

k=a coefficient which depends upon the density, size and shape of the solid

A=the projected area of solid.

v=the setting velocity

From experiments conducted with fractions from typical samples of slimes, an average value for k would appear to be 0.079.

J. Levin—Metallurgical Research in South Africa

The process of gold extraction is being reviewed and improvements are being introduced as a result of research carried out both in the laboratories and on the plants. In some mills, improved efficiency is being obtained by the introduction of large diameter mills and by the use of autogenous grinding, which by feeding run-of-mine ore to the large diameter mills dispenses with balls, rod mills and crushing equipment. Automatic control of feed and of pebbles, where pebble mills are used is being introduced with the aid of the research laboratories and in this connection the Williamson electronic control developed in the Union Corp. laboratory can be mentioned.

Uranium extraction is receiving due attention at the group laboratories, working in conjunction with the operating plants. Examples of some of the recent and current investigations are:

1. Automatic determination and recording of the uranium content of solutions in the ion-exchange plants; photometric and polarographic methods have both shown promise but current work is devoted to the latter method.

2. The possibility of applying solvent extraction instead of ion-exchange; South African conditions are favorable for the latter process but experimental data obtained with solvent extraction have shown sufficient promise to justify continued investigation.

3. Autogenous pressure leaching; batch and small scale continuous tests have yielded encouraging results, and the process offers possibilities of more economical operation than normal leaching.

4. An improved resin-in-pulp process; a novel principle is employed in a process that is being developed.

5. Auto-oxidation; a successful process has been developed for the oxidation of sulphur dioxide and ferrous sulphate by air.

6. Ion-exchange; various aspects are being investigated, such as alternatives to nitric acid elution, resin regeneration and the possible use of resins discarded from the uranium plants.

A large part of the work of the group research laboratories relates to the field of metallurgy outside gold and uranium extraction, and here again it is only possible to quote a few examples in illustration of the work being carried out.

1. Laboratory and plant investigations by one mining group have enabled a beach-sand concentrating plant for the extraction of ilmenite, rutile and zircon to be established and further investigations aim at improving the operation of the plant. In another mining group, a more difficult treatment problem was presented by a partially consolidated sandstone containing titanium minerals and zircon, but a considerable measure of succes has been obtained in laboratory tests.

2. A technically satisfactory process for the concentration of a difficult fluorspar ore has been developed.

3. The treatment of South Africa's vast reserves of chromite, most of which have a low chromium-iron ratio, is receiving attention. Several improvements in gravity concentration, including the development of an accurate classifier, have been tested, but few have been applied due largely to the fact that under prevailing conditions in South Africa, simplicity of design and operation, and low operating costs are economically more important than high technical efficiency. The reduction of the iron content of the ore, and the extraction of the chromium, in the metallic form or as chemical compounds provide a wide field for research, and considerable effort is being devoted to these problems by mining and industrial concerns.

4. Platinum extraction. After many years of platinum recovery in South Africa, several of the mining groups have found it necessary to investigate the analysis, concentration and extraction of platinum and the platinum group metals.

5. Superphosphate manufacture. An investigation that started as a problem of disposing of roaster gases led to the manufacture of sulphuric acid and to a novel and successful process of superphosphate manufacture.

6. Revovery of vanadium. Laboratory investigations have enabled a 90% recovery of descloizite to be attained by flotation, from a complex zinc-lead-vanadium ore. Investigations on the extraction of vanadium from the Transvaal titaniferous magnetities have led to improved methods of extraction by one of the mining groups and also by industrial firms.

7. Phosphate concentration and treatment. Concentration processes for several phosphate deposits outside South Africa have been developed. The utilization as a fertilizer of the citric-acid soluble phosphate from one of these deposits is being investigated and it is interesting to note that the function of the group laboratory concerned will be extended to the conduct of pot and field tests to establish the value of the fertilizer.

8. Concentration and extraction of columbium. Processes for the treatment of pyrochlore from various deposits outside South Africa have received much attention, and several promising methods of treatment have been developed.

9. Concentration and extraction of copper zinc and nickel. Various deposits within the beyond the Republic of South Africa are being investigated.

LET US KNOW WHEN YOU'RE READY TO BOLT YOUR ROOF ...WE'LL SEND A BETHLEHEM ENGINEER TO DISCUSS IT WITH YOU

Our roof bolt engineers are specialists. By testing strata, they can recommend proper bolting procedures, and torque. They'll help to get your men started on the bolting. And they'll check back with you to test and inspect.

The assistance of our able engineers—and the use of dependable Bethlehem roof bolts—can increase both safety and efficiency in your haulageways and tunnels.

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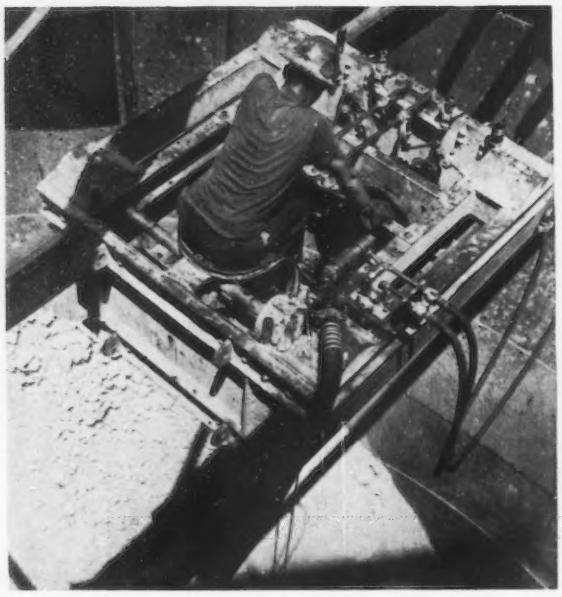
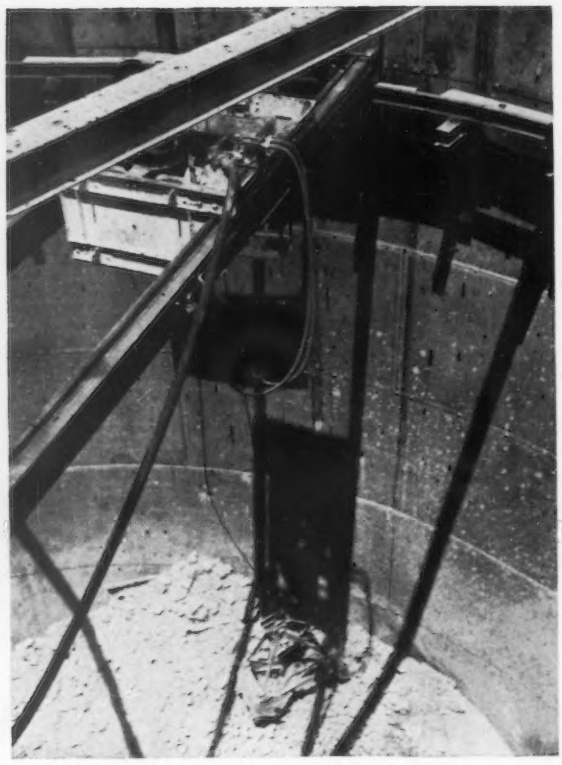
OPERATING IDEAS





Clamshell Mucker Cleans San Manuel's Bins

AT SAN MANUEL Copper Corp.'s mine, Tiger, Ariz., production is hoisted to the surface through two identical four-compartment shafts. Eighteen-ton bottom-dump skips automatically discharge into steel loading bins close to each 160-ft steel headframe. The 60-ft-dia bins hold 5000 tons of ore.

San Manuel's problem: Wet ore, dumped into the bins resulted in material build-up around the two discharge chutes at the bottom. In time, these buildups seriously reduced the over-all capacity of the bin. To overcome this difficulty, several methods, including compressed air jets, were tried to loosen and disintegrate the material build-ups. None proved effective.

Finally, a mucking unit employing a clamshell was designed and constructed. It operates on a circular track installed inside the bin. The mucker has proved itself a versatile bin auxiliary, for it can be used for rapid and economic removal of packed and built-up material in the bin, as well as serve as a crane when not used for mucking purposes. Typical crane jobs are carrying out chute liner and side bin repairs, and removing timber, steel and other objects that might block the chute openings.

The installation consists of an air-operated hoisting unit employing a clamshell operating on a steel frame with track, and a circular track attached to 48 steel hangers or supports. One end of the frame is equipped with a truck, with the wheels positioned at a slight angle to permit smooth operation on the circular track, while the other end is coupled to a bearing assembly bolted to the H-beam brace in the exact center of the bin.

Both the circular track and the mucker frame are installed so that the unit and operator will clear the bin bracing near the top at all times. Hoist motors are air-operated, as are the motors propelling the mucker on the frame below and the mucker frame around the bin circumference. Any part of the bin can be reached by the clamshell. The installation resembles a Riddell mucker used in shaft sinking.

Spray Gun Lubricates Ropes in South Africa

AN EXPERIMENT with a new and speedier method of lubricating mine hoist ropes by sprays instead of grease boxes is nearing completion in South Africa.

Noxal Co. (S.A.) Ltd. of Johannesburg followed up reports that mine consulting engineers were interested in a method of lubricating mine hoist ropes with liquid dressing instead of heavy grease. The liquid dressing would lubricate the ropes internally.

The company engineers rigged up a mock headgear in the yard of the company's premises and experimented with an Atlas Copco Ecco 30A automatic spray gun intended for mass-production painting and for other industrial purposes such as oiling and wetting and designed for automatic operation on a permanent mounting. These experiments gave them an indication of the spread of the oil.

On the instructions of the consulting engineers of the Van Dyk Consolidated Mines, Boksburg, Transvaal, the company installed their unit—three guns rigged at a 120° angle to each other on a horseshoe plate—around the hoist rope. The unit was mounted immediately below the sheave where whipping of the rope is at a minimum.

To establish the periods for which the guns should operate, four Noxall engineers sat in shifts in a day and night vigil in the headgear for several weeks operating the spray guns manually. The automatic unit was then installed with micro switches operating a solenoid air valve to trigger the pressure to the sprays. The unit also contains a memory switch to record the number of trips done. A preliminary test showed the oil was penetrating to the core.

Dayco CORPORATION

Dayton Industrial Products Co. Div. Melrose Park, Illinois

PROBLEM:

A highway job -- where air hose attached to an Ingersoll-Rand Crawlmaster Drill is dragged over rough terrain covered with sharp rock -- hose has to be "more than ordinary" to stand such abuse.

SOLUTION:

DAYTON MAXIMAIRE* HOSE

Specifically designed for heavy-duty service, Dayton Maximaire Hose provides longer service life and fewer failures. The outer cover (A, left) is made of tough neoprene rubber compounded to withstand cutting and extreme abrasion. High-strength rayon, braided to give greatest flexibility (B), adds great strength...alternate rubber layers (C) insure positive adhesion between braids, cover and the inner oil-resistant, seamless extruded tube (D). The result on this extensive rock-drilling job has been far less downtime for hose replacement. To fit your needs, Dayton Maximaire Hose is available in local stocks in 25 ft or 50 ft lengths. Lengths up to 75 ft are also available, coupled or uncoupled, 1/2" to 2" I.D. Test this new flexible hose on your job.

See HOSE in the Yellow Pages of your phone book for the name of your nearest Dayton Distributor.

*T.M. ©D.C. 1961

PERSONALS

Kennecott Swaps Shop-Talk

KENNECOTT Copper Corp.'s Milling Practices Committee met at the company's Chino Mines Division May 22-24 to discuss common problems and exchange ideas. The group meets quarterly on a rotating basis at locations in Utah, Nevada, Arizona and New Mexico. Each of Kenncott's Western Divisions is represented. The Milling Practices Committee is one of three (the others: Smelting & Fire Refining Practices and Mining Practices) which meet periodically to compare notes. Attending the May meeting were: (back row, l to r) **J. W. Ribotto,** mills metallurgist, Utah Copper Div.; **P. A. Lemke,** mills metallurgist, Chino Mines Div.; **R. R. Leveille,** concentrator superintendent, Nevada Mines Div.; (center row, l to r) **F. D. Thayer,** concentrator superintendent, Nevada Mines Div.; **E. C. Speers,** Western Mining Div., Engineering Dept.; **T. J. Hubbard,** Magna Concentrator superintendent, Nevada Mines Div.; **H. D. Cox,** mill metallurgist, Ray Mines Div.; (front row, l to r) **J. R. Denny,** scheduling foreman, Nevada Mines Div.; **A. W. Last,** Western Mining Division, Research Center; **A. T. Shukas,** concentrator superintendent, Ray Mines Div.; **N. Plummer,** Arthur Concentrator superintendent Utah Copper Div. A. W. Last is committee chairman.

Louis Kettler has been named research engineer to the staff of American Zinc Institute - Lead Industries Association Expanded Research Program. His duties will include the administration of research projects with special emphasis on cost studies, project initiation and monitoring, and technical reports.

Kettler

Kettler had previously served as project engineer in charge of research and development for Continental Copper & Steel Industries, Inc., New York City. During the same period, he served as staff consultant to Welin Davit & Boat Division on problems covering the development and evaluation of new materials and products involving metals, reinforced plastics and plastic foams.

Before joining Continental Copper & Steel, Kettler was technical manager, special products, with Consultants & Designers, Inc., New York City.

Kettler is a professional engineer licensed in New York State with a degree from New York University. He is a member of the American Society for Metals, the National Association of Corrosion Engineers, and the Society of Plastics Engineers.

Alexander B. Kane has been named superintendent of Anaconda's East Helena, Mont., slag treating plant, succeeding **Robert L. Thompson,** who retired at the end of May. Kane had been assistant superintendent. **Howard K. Bardwell** is now assistant superintendent at the plant, having transferred to the East Helena plant last March from Tooele, Utah, where he had been assistant lead plant superintendent for International Smelting & Refining Co., an Anaconda subsidiary.

A. H. Schoemaker became consulting engineer at the Homestake Mining Co., effective June 1. At his request, he has been relieved of the responsibilities of the position of vice president and general manager. As consulting engineer, Shoemaker will serve in an advisory capacity, but will continue to maintain close touch with all Homestake operations through frequent visits.

Frank Windolph has been named general superintendent for Climax Molybdenum Co.'s Climax, Colo., operations. He had been assistant general superintendent since 1959. William Distler, former mine superintendent, becomes assistant general superintendent, succeeded by Charles Cleeves.

Walter A. Sterling has retired as board chairman and chief executive officer of The Cleveland-Cliffs Iron Co. He will continue as a director of the company. H. Stuart Harrison, president since May, 1960, becomes president and chief executive officer, and John S. Wilbur, vice president, ore sales and marine, was elected senior vice president.

Charles M. White, honorary chairman of Republic Steel Corp. was awarded the Gary Memorial Medal, the highest honor of the American Iron and Steel Institute, at the banquet session of the Institute's 69th General Meeting, May 25. The medal was awarded in recognition of White's "outstanding achievements as a strong and successful leader in a keenly competitive industry, in well earned recognition of his important contributions to the development of his company and his devotion and service to the entire iron and steel industry."

Floyd S. Weimer, manager of the Great Falls reduction department of The Anaconda Co., retired July 1. He is succeeded by **Lawrence J. Ingvalson,** formerly general superintendent of the Great Falls plant. **Leonard C. Powell** becomes general superintendent.

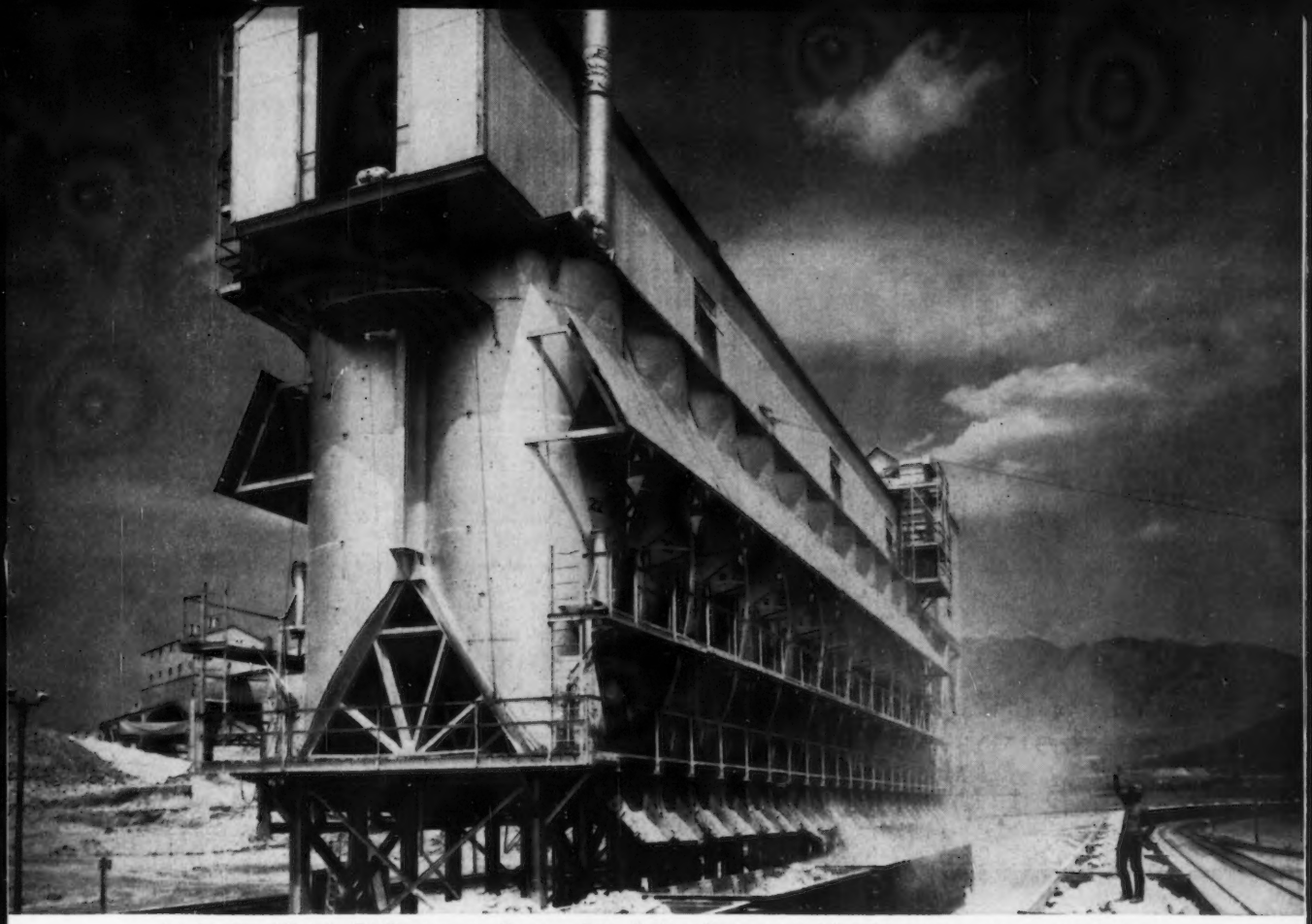
Distinguished Achievement Medals, the highest honor the Colorado School of Mines may bestow upon a graduate, were presented to five Colorado School of Mines alumni during the June 2 Commencement ceremonies. They were: **Lloyd E. Elkins,** '34, production research director for Pan American Petroleum Corp., Tulsa, Okla.; **Harry L. McNeill,** '24, director, vice president and manager of metallurgy and chemical division Stearns Roger Manufacturing Co., Denver; **Domingo Moreno,** '22, manager of mining and metallurgical division, Brown & Root, Inc., New York City; **Thomas A. Manhart,** '30 and '33 chairman of the board, Century Geophysical Corp., Tulsa; and **Karl F. Dallmus,** '27, consulting geologist, Caracas, Venezuela.

OBITUARIES

Clayton Harold Dunham, 65, died May 17 at Duarte, Calif., following a long illness. Dunham worked with his father and brothers to expand the lead and zinc industry in the West, and had long been a prominent figure in Western mining. He was born in Brightwater, Ark.

Charles H. Jenkins, 54, died May 22 at Denver, following a long illness. A graduate of the Colorado School of Mines, he spent several years as a mining engineer in the U.S. and South America. For the last twenty years, he had been employed by the Stearns-Roger Manufacturing Co. Denver office. He was appointed assistant manager of the company's Chemical and Metallurgical Division in 1948.

Martin Cahill, 86, died May 29 at Cheyenne, Wyo., after a long illness. A Wyoming labor leader for more than forty years, Cahill was president of the Wyoming United Mine Workers union from 1912 to 1932, and president of the Wyoming Federation of Labor from 1932 until his retirement in 1952.



Loading bins at Berkeley Pit, The Anaconda Company, Butte, Montana. Copper ore is delivered by a system of conveyor belts from crusher to these 22 bins lined with tough, 321 minimum Brinell USS "T-1" Steel. Railroad cars are loaded in ten to fifteen seconds each.

"T-1" Steel bin linings handle 21 million tons of copper ore with only 1/16" wear!

Abrasive copper ore cascades into these 5,000-ton capacity loading bins at the rate of 28,500 tons per day. Chunks of ore up to 12 inches in size are included. For more than 28 months, the USS "T-1" Steel (321 minimum Brinell) plates lining the Berkeley Pit bins of The Anaconda Company, and those diverting the ore to the car-loading chutes, have been taking this punishment.

Mr. Carl Lundborg, Chief Engineer, The Anaconda Company, Butte, Montana, says,"We consider this a remarkable performance record for any such steel. We took spot checks at the point where greatest wear occurs —the gate of the bins. At the time they showed *1/16" wear on the 3/8" and 3/4" plate!*"

The entire side and bottom liners consist of 163 tons of USS "T-1" Constructional Alloy Steel of 321 minimum Brinell hardness. "T-1" Steel Plates are now available heat-treated to a minimum hardness of 360 Brinell in thicknesses up to 1½ inches for even greater resistance to impact abrasion.

"T-1" Steel truck liners, too, showed outstanding resistance to impact abrasion. Very little repair service has been required on 15 truck bodies lined with ¾" plates of "T-1" Steel on the bottoms and ⅜" plates on the sides. These have been in service about three years hauling average loads of 36 tons per trip or 800 tons per truck shift. The total pit operation is 28,500 tons of ore and 72,000 tons of waste rock each 24-hour operating day.

Other applications of "T-1" Steel at Anaconda include bulldozer mold boards, skirt plates on the tripper mechanism over the loading bins, and many parts for the two-car tipple where extra strength was needed for handling the larger 75-ton cars.

For more information on USS "T-1" Steel (with 321 or 360 minimum Brinell hardness) and the new USS "T-1" type A Steel (also available with 321 minimum Brinell hardness, if desired), write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania. USS and "T-1" are registered trademarks.

United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal & Iron Division • United States Steel Supply Division • United States Steel Export Company

This mark tells you a product is made of modern, dependable Steel.

United States Steel

STILL AFTER 10 YEARS in THE FIELD THE WORLD'S LARGEST EXCAVATOR ON TWO CRAWLERS

A 12-yarder loading tough taconite on the Iron Range.

At 13 yards a crack, copper haulage units do very little waiting.

This 12-yarder is in one of the world's largest quarries.

Two giants! 13-yard shovel and 80-ton dump team up in copper.

10-yard barge mounted unit on Niagara Falls Power Project.

This 13-yard unit will fill a bottom dump in three passes.

This 14-yard dragline set a loading record at a dam project.

This veteran dwarfs 30-ton rail cars in a copper pit.

The newest member of a very exclusive family . . . an 11-yard 191-M with full static control loading taconite on the Iron Range.

Almost twice the capacity of the previous largest machine of this type, the Marion 191-M has been tested in some of the hardest digging to be found in the world over the past decade. In taconite on the Iron Range, in major copper producing areas, on large scale earthfill projects, in cement, in limestone.

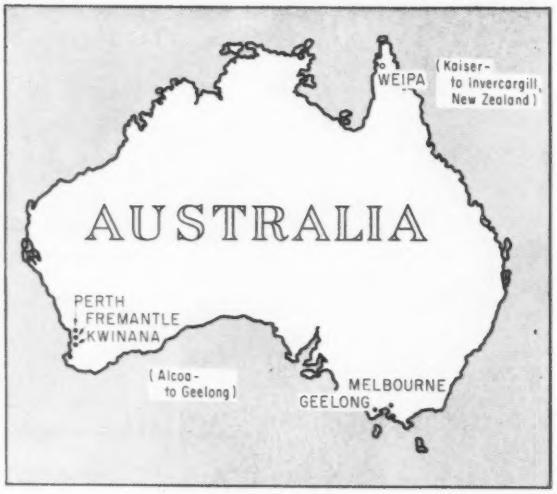
Results? It has helped set a world's record for earth excavation . . . teamed with larger haulage units to cut wider benches . . . consistently set lower mining costs . . . established new levels of operating efficiencies.

Yet, as good as this machine was—Marion has made it even better. Ten years' experience in the field has naturally indicated where improvements could be made and today's machines incorporate the benefits of such experience.

The Marion 191-M is THE machine for the modern day requirements of really big jobs. For example, this year a Marion 191-M went to work on the Iron Range utilizing the first *complete* static control system in the industry. In its operating economies and its ability to move more for less it combines factors that presage brighter pit profits in the years ahead. It's the ONLY machine in the 10-13 cubic yard size fully field tested and waiting for you. A Marion mining specialist will be happy to fill you in on the details.

MARION POWER SHOVEL COMPANY • MARION, OHIO

A Division of Universal Marion Corporation



ALUMINA produced from bauxite fields Kwinana will be shipped 1700 miles to the smelter at Geelong. Kaiser's new project (E&MJ, December 1960, p 100) will mine at Weipa, on Cape York and process to metal in New Zealand.

Alcoa Plans Aluminum Complex in Australia, New Smelter in Mexico

TWO MAJOR NEW ALUMINUM PROJECTS, one in Australia and one in Mexico, are being undertaken by Aluminum Company of America, for an estimated total investment of $116.5-million. The largest investment, for $100-million, will go into a joint venture with two Broken Hill mining companies and with Western Mining Corp. of Australia.

In that venture, which will eventually create an output of 40,000 tons per year of aluminum metal, Alcoa will, through the new company—Alcoa of Australia Pty. Ltd.—mine ore at the west coast area near Kwinana, process it to alumina in a plant to be built nearby, and ship alumina 1700 miles across the Great Australian Bight to Geelong and the smelter which will be built there. Production is due in 1964. A fabricating plant will also be built near the smelter site.

Ownership of Alcoa of Australia Pty. Ltd. is 51% Alcoa, 49% Western Mining Corp., North Broken Hill, Ltd. and Broken Hill South Ltd.

In Mexico, Alcoa is entering an agreement with Intercontinental S.A. and other Mexican industrial groups to build a smelter of 20,000-ton capacity at Vera Cruz, on the Gulf of Mexico. Another large participant is American & Foreign Power Co. The smelter will process alumina from Alcoa's Point Comfort, Tex. plant which is in turn fed bauxite from deposits in Surinam and the Dominican Republic.

In the Mexican arrangement, Alcoa will manage and operate the facility and hold 35% of control of the firm, with AFP holding 14%.

Funds for the project will come from the Export-Import Bank, as a U.S. equipment procurement loan, AFP, Alcoa and Mexican investors. Power will be supplied from the Amascal hydroelectric dam in the Papalopan Basin and from a projected thermal station at Vera Cruz. Some 40,000 kw is expected to be needed.

Alcoa is taking part in the Brokopondo Project in Surinam in another aluminum project.

Ground breaking for the Vera Cruz project was to take place in late June. Alcoa officials called the new arrangement a part of a new approach to Latin American investment. It also agrees with the provisions of the "Mexicanization" law for foreign investment, recently passed. Mexico currently consumes some 17,000 tpy of aluminum, but its rise in consumption should bring it to 20,000 at about the same time the Vera Cruz plant goes on stream.

Moscow Promises Aid to Cuban Nickel Production

ACCORDING TO REPORTS published in Moscow, the Soviet Union and Cuba have signed an agreement whereby the latter will receive technical aid in the development of nickel production. Soviet organizations will carry out the necessary research and design work. Soviet technical specialists will be sent to Cuba.

St. Joseph Lead Sells Its Interest at Bathurst

LATE LAST MONTH St. Joseph Lead Co. sold its 40% interest in the Brunswick Mining and Smelting Corp. for $10.5-million to Patino Mines of Canada, Maritimes Mining Corp. Ltd., and Canadian industrialist K. C. Irving.

St. Joe first took an interest in the large lead-zinc-copper orebody in 1953, and assumed management responsibility for the project. Intensive studies into the complex metallurgy of the ore was undertaken and an exploratory shaft sunk.

According to THE NORTHERN MINER the new company will be headed by E. R. E. Carter, managing director of Patino, and an expansion from 2,000 tpd to 3,000 tpd in mill capacity will begin shortly.

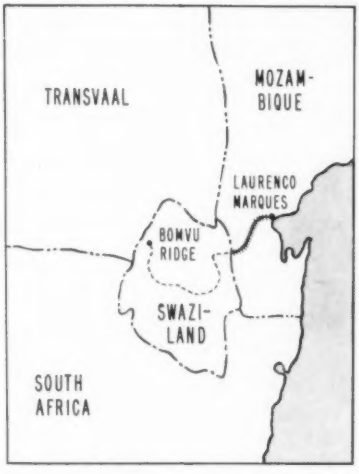
A new smelter to handle the Bathurst output will be constructed by East Coast Smelting and Chemical Co., and will probably use the Imperial Smelting Co., Avonmouth process. East Coast Smelting is one of the M. J. Boylen interests. Mr. Boylen is also one of the prime movers of Brunswick.

Rail Link to Bomvu Ridge Is Okayed

THE LONG AWAITED and much debated 200-mile railway line from Anglo American's rich iron ore deposits at Bomvu Ridge in Swaziland to the connecting railhead in the Goba district of Mozambique has received approval by the British government. Construction will start in 1964 from the deposit of 67% Fe, located near South Africa's Transvaal border.

Cost of the railway is estimated at R£ 16-million, with the complete project, including mining and auxiliaries to run to R£ 100-million. The line will be built by the Colonial Development Corporation of Britain, possibly with the help of a World Bank loan and with similar aid from Anglo American. Another part of the arrangement includes deepening of the port of Laurenco Marques and construction of loading docks, to be borne by Mozambique.

Ore from the open pit mine has already been contracted for by a syndicate of Japanese steel concerns, led by Fuji and Yawata, which will take some 1.2-million tons of the ore annually for a 10-year period at a contract price of R£ 7 per ton. Partners in the iron ore deal with Anglo-American is the British firm of Guest, Keen and Nettlefold.



Specify Anaconda all Butyl Shovel Cable

This new shovel cable—the toughest in the industry—cuts shovel downtime. Months of torture testing throughout the country have proved it.

It endured the rugged cold of the Mesabi and the punishing heat of Florida's phosphate mines.

It was twisted, kinked, soaked, crushed and run over.

Its new Butyl *jacket* is the reason for this extra durability in the face of the effects of ozone and moisture and extreme physical punishment.

It is especially compounded to combine flexibility at low temperatures with thermal stability at high temperatures.

Here are other construction features which contribute to this cable's unequalled service record:

1. Anaconda's rubber-core grounding conductors offer a cushioning effect which minimizes pinching and wire breaking and offers greater ground contact protection.
2. Special shielding—a combination of copper cross-braided with cotton—eliminates chafing (and makes splicing faster and easier too).
3. Insulation is a special high-grade Butyl that withstands ozone, heat, and moisture.

Check all the features of this job-proved new shovel cable—they add up to extra cable life, less downtime, and dollar savings. Contact Department EFL-1-PQ, Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y.

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ANACONDA®

ABOUT ALL-BUTYL SHOVEL CABLE

from drilling ... American Cyanamid products and services help

Lower blasting costs in the mine!

Until a year ago, all shots at B. S. & K.'s Silverbell, Arizona Atlas Mine were fired with 40% standard gelatin dynamites. In January of 1960, however, test shots showed that Cyanamid's ammonia dynamites CYADYN® No. 5 and CX-327 were equally effective, more economical and produced fewer annoying fumes. CYADYN No. 5 was chosen for its higher stick count and has given satisfactory, economical breakage. Fragmentation is approximately minus 6" in ore and 10" to 12" in waste. No set blasting pattern is followed because of irregularities in the ore-bearing strata. In drifts and raises, a center cut is made with a "5-hole burn" with the outside 4 holes shot to the unloaded center hole. The rest of the round is broken to the center cut. Similar blasting procedures using Cyanamid regular delay electric blasting caps are being used in sinking a new 600-foot shaft.

Cyanamid's complete assortment of dependable high explosives, permissibles, blasting agents, electric blasting caps and other blasting accessories are available for prompt delivery from a nationwide network of plants and magazines.

Explosives • Blasting Caps and Accessories • Blasting

to milling ...

B.S.&K. Mining Company improve operating economy!

Lower cost-plus-tails in the mill!

Since 1951, B. S. & K. has treated sulfide ore assaying 0.5 to 3% Cu and 16 to 32% Zn, in a 100-ton/day selective flotation mill. Mill feed averages less than 1% Cu and 25% Zn. Copper occurs as chalcopyrite.

Original reagent use called for 0.1 lb./ton AERO® Promoter 404 in ball mill and 0.35 lb./ton SODIUM AEROFLOAT® Promoter in zinc circuit. In 1959, when it became economically attractive to maintain a zinc concentrate grade of not less than 60%, Cyanamid's local Field Representative and B. S. & K. personnel reworked the reagent schedule.

By using Cyanamid Experimental Reagent S-3258, a new oily collector, as zinc circuit collector, zinc recovery is maintained at 98 to 99% despite wide variations in metal content of feed. Zinc concentrates now assay well over 61% zinc, compared with a previous average of 58.5%. AERO Depressant 633 in zinc cleaner circuit helps depress undesirable lime and magnesia gangue. AEROFROTH® 77 Frother appears more selective toward gangue than other frothers and substitution of AERO Xanthate 343 for AERO Promoter 404 has improved selectivity in copper circuit. These changes have reduced reagent consumption, improved both concentrate grades and over-all recovery and made metallurgy at this mill outstanding in its field.

Cyanamid offers the widest range of metallurgical chemicals available from a single source. Our experienced Field Representatives, backed by the services of our Mining Chemicals Laboratories, stand ready to advise you in the selection and use of the best reagent combination for your mill.

FROM DRILLING TO MILLING, SPECIFY

CYANAMID

AMERICAN CYANAMID COMPANY
EXPLOSIVES AND MINING CHEMICALS DEPARTMENT
BOUND BROOK, NEW JERSEY

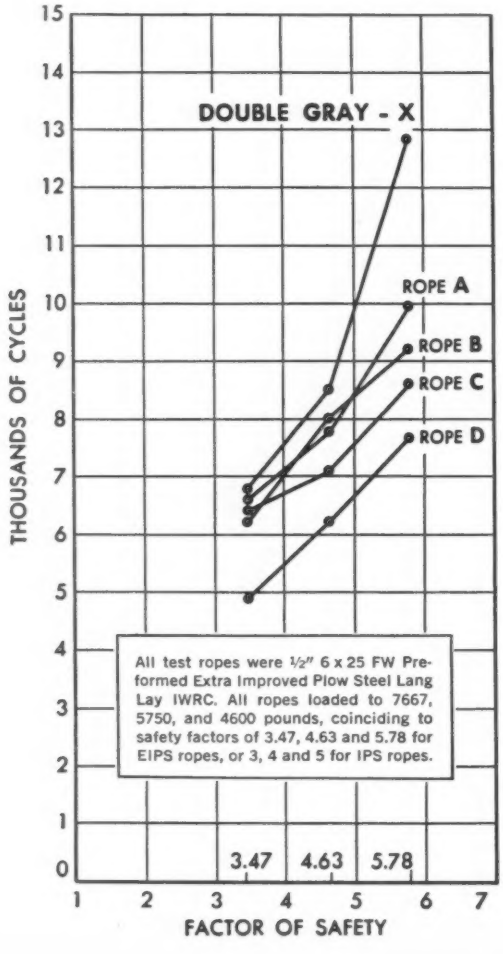
Agents • AM-9 Chemical Grout • Mining Chemicals

DOUBLE GRAY-X® lasts longer

Tests prove CF&I-Wickwire's premium wire rope has 45%* more bending life than average of other ropes tested

In an extended series of tests conducted at CF&I's Palmer Plant, five brands of wire rope were tested to destruction on a 25,000-pound fatigue machine that bends wire rope back and forth over sheaves until it breaks.

All the ropes tested were made by major manufacturers, and were identical in size and specification. And all exceeded the catalog-breaking strength of extra-improved plow steel rope. But, as the chart indicates, one rope outlasted all the others at every safety factor used in the test. That rope was Double Gray-X!


DOUBLE GRAY - X
ROPE A
ROPE B
ROPE C
ROPE D
THOUSANDS OF CYCLES
FACTOR OF SAFETY
3.47
4.63
5.78
All test ropes were ½" 6 x 25 FW Preformed Extra Improved Plow Steel Lang Lay IWRC. All ropes loaded to 7667, 5750, and 4600 pounds, coinciding to safety factors of 3.47, 4.63 and 5.78 for EIPS ropes, or 3, 4 and 5 for IPS ropes.

At the highest and most commonly-used safety factor, CF&I-Wickwire's premium wire rope lasted 30% longer than the rope that survived next longest, and 68% longer than the rope that lasted the shortest length of time. Double Gray-X lasted 45% longer than the average of all other ropes tested at this safety factor.

Double Gray-X has greater resistance to bending fatigue, the chief enemy of wire rope life, because it is the result of a breakthrough in wire-drawing technology. The use of molybdenum disulphide in the drawing process produces these outstanding fatigue-resistance factors:

- A Molecular Shield . . . which prevents the wires from grinding together as the rope operates.
- Smoother Wire Surfaces . . . providing better resistance to fatigue.
- Extra Toughness . . . because molybdenum disulphide helps preserve the inherent toughness of the wire during drawing.

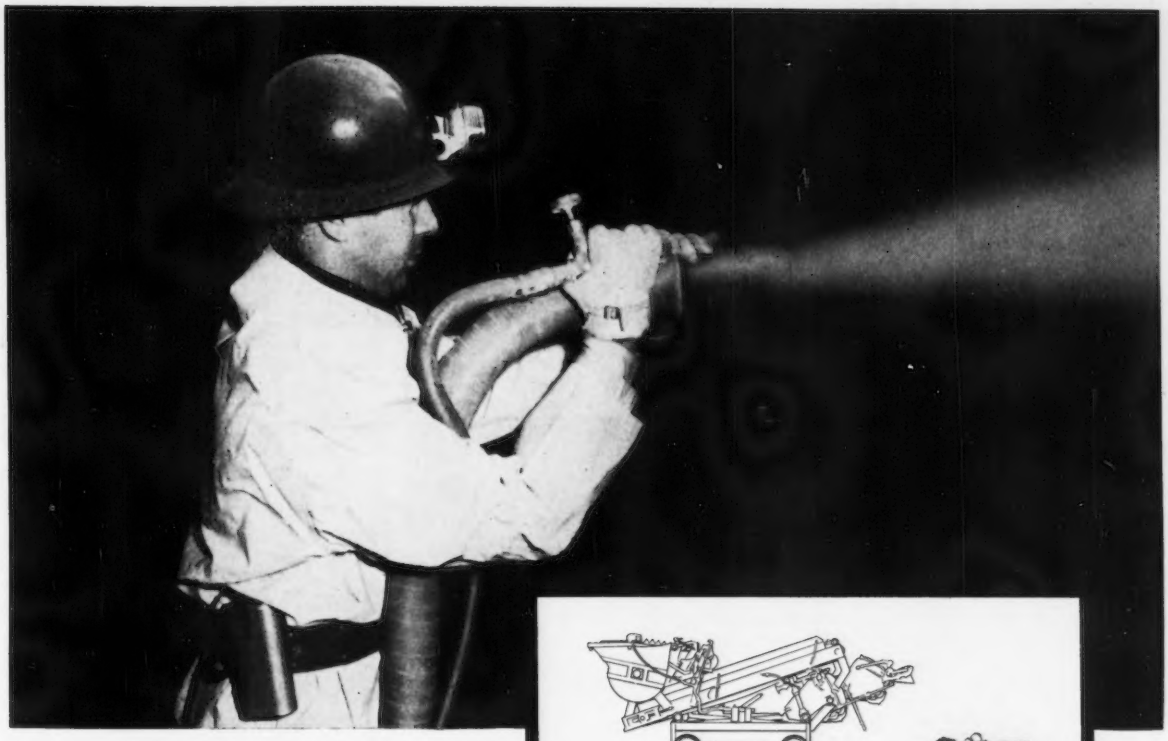
Double Gray-X can save you money because it lasts longer on even the most punishing jobs, as proved by these tests and by field reports from satisfied users. This longer-lasting wire rope cuts repair and replacement costs, lowers your total wire rope investment and reduces machine downtime. Use the wire rope of *tomorrow* today! Ask your CF&I salesman for complete details.

*Percentage above average of all other wire ropes tested at safety factor of 5.78.

The Colorado Fuel and Iron Corporation

Denver • Oakland • New York
Sales Offices in All Key Cities

6102

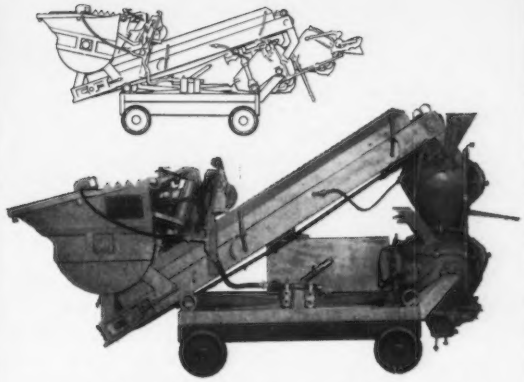


RIDLEY MODEL C-3UG
COMPACT, FULLY INTEGRATED
CONCRETE GUNNING RIG

places concrete at low cost anywhere in mine or tunnel

C-3UG goes everywhere underground ... lines and reinforces at rates up to 12 tons per hour!

Ridley's new concept of low cost reinforcement in mines and tunnels allows application of concrete with minimum interruption. C-3UG collapses (or disassembles if necessary) for passage through restricted drifts. It guns up to 12 tons per hour continuously, and easily seals off even appreciable flows of ground water. Your men can operate it at a cost far below that of timbering, lagging, bolting, or pouring concrete... and do a *better* job!



SPECIFICATIONS: Only 5'6" high in shooting position, 4'2" collapsed; 3'6" wide . . . mounts on mine car, skids, or pneumatic-tired trailer . . . powered by mine air line or compressor . . . reduces rebound loss and cleanup by 50% . . . simple design needs little maintenance. It's a profitmaker any way you look at it! **Mail coupon today.**

RIDLEY

AND COMPANY, INC.

2217 PONTIUS AVENUE • LOS ANGELES 64 • CALIFORNIA

RIDLEY AND COMPANY, INC.
2217 Pontius Avenue • Los Angeles 64, California

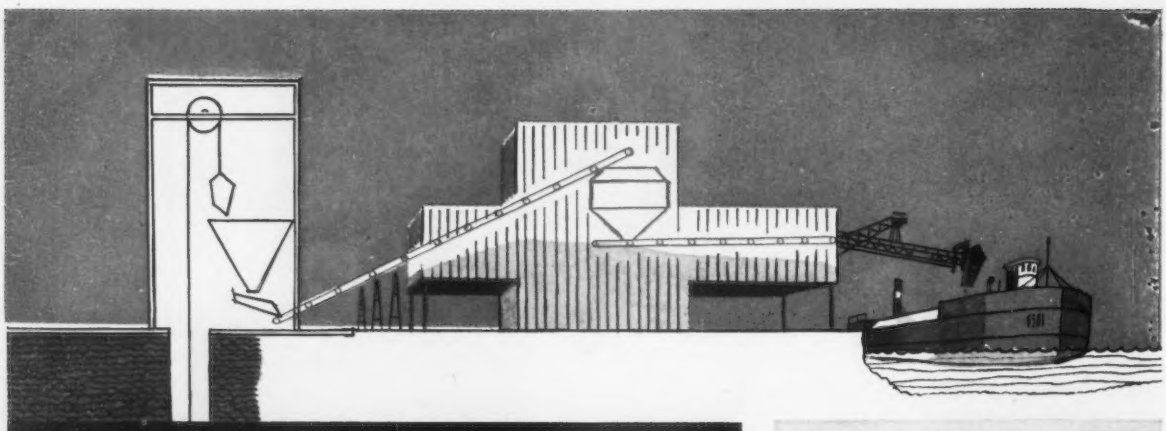
☐ Send me name of nearest Ridley representative.
☐ Rush complete data on Ridley C-3UG

NAME_____

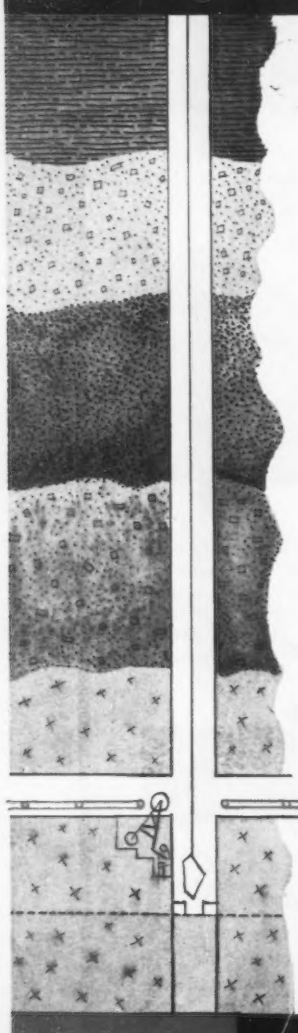
COMPANY_____

ADDRESS_____

CITY_____ STATE_____



Surfacing the SALT OF THE EARTH



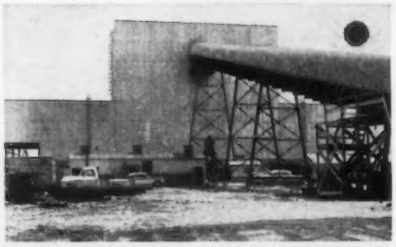
The International Salt Company's $11,000,000 operation on Whiskey Island, Cleveland, Ohio, is a perfect example of modern, efficient bulk handling methods to provide the ultimate in customer service. For this operation, the Bulk Systems Division of Jervis B. Webb Company furnished 28 belt conveyors and shuttles, and one high capacity shiploader for the new surface plant.

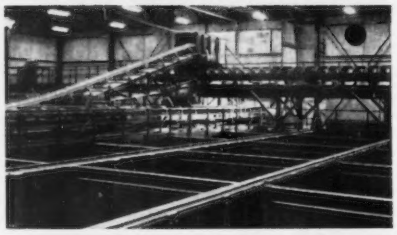
THE PRIMARY BELTS, from the production shaft into the storage area, are 36″ wide with a 700 ton per hour capacity. This includes a large traveling bridge conveyor for loading into the 36 compartment storage bins.

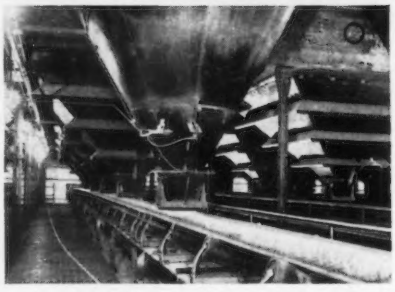
THE SECONDARY BELT CONVEYOR SYSTEM, handling the salt from the storage area, consists of 30″ belts @ 400 TPH, including 7-30″ shuttle conveyors for distributing the product to railroad cars and trucks.

THE TEMPORARY BELT CONVEYOR SYSTEM consists of 7-24″ belts and 1-30″ belt. These belts, along with crushing equipment installed by Bulk Systems, will eventually be reinstalled underground when sufficient salt has been removed to make room for the equipment.

- **Main 36″ inclined belt from production shaft surge bin to top of storage buildings is housed within a totally enclosed gallery structure.**
- **Traveling bridge conveyor consists of a movable tripper running fore and aft over the storage area with a reversible cross-belt shuttle mounted on the tripper structure to receive the discharge from main belt and feeding the salt into the storage pockets right and left.**
- **Detail of some of the 30″ collecting belts under the 36 storage pockets. Conveyors are horizontal and reversible. All gates on underside of the pockets are air operated and remote controlled.**
- **48″ wide 1250 TPH shiploader which is fed from 48″ conveyor. The shiploader extends and retracts, with vertical boom-end movement to follow rise and fall of the ship. Salt is continuously weighed while being carried by this system.**







BULK SYSTEMS • DIVISION OF JERVIS B. WEBB COMPANY

8951 Alpine Avenue • Detroit 4, Michigan

Huge Ventilation Project Is Scheduled by Anaconda

MORE THAN $1,250,000 will be spent by the Anaconda Co. on a major ventilation project for the Steward Mine in Butte.

According to E. I. Renouard, vice president of the Anaconda Co. work on the project has already started.

The new program will extend the Never Sweat shaft from the 2800-ft level on an incline to the 4500-ft level of the Steward. It will provide a new exhaust outlet of 300,000 cubic ft of air per minute from lower levels in the southeast section of the Steward.

Renouard said, "This is one of the largest single mine ventilation projects Anaconda has undertaken in Butte for many years. The new airway will overcome the problem of heat and give us good working conditions in an area which contains large reserves of copper ore. It will prepare the Steward for possible maximum production when the Kelley Mine central hauling and hoisting facilities are completed for the new deep-level mining program."

The job, which will take 18 months, involves extending the Never Sweat shaft for 1880 ft. The extension below the 2800-ft level will be a circular, concreted section with an inside diameter of 14 ft. It will be the longest continuous exhaust outlet in the Butte district.

When completed, the new project will increase Steward mine air circulation to 550,000 cubic ft of fresh air per minute. Air intakes will be through the Steward, Original, Kelley, Buffalo, Colorado and Belmont and exhaust through the West Gagnon, Parrot, Parnell, Green Mountain and Never Sweat shafts.

Men and material service for the Never Sweat project will be through the High Ore mine shaft to the 2800-ft level. The Never Sweat hoist will be used for sinking service.

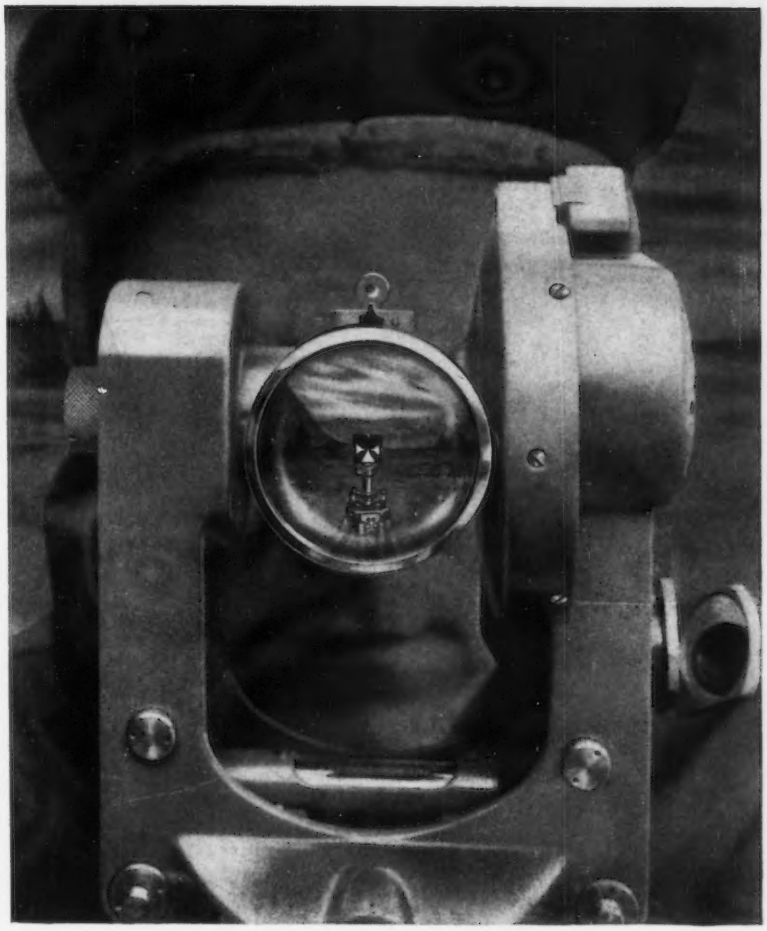
Crucible Vows a Fight Vs. Foreign Drill Steel Flood

LOW-COST FOREIGN COMPETITION, the bane of many domestic mineral producers, is now taking its toll among mining equipment manufacturers in the U.S. as well. The AMERICAN METAL MARKET last month reported that Bethlehem Steel Co. has stopped the manufacture of hollow drill steel and noted that "trade sources estimated that foreign producers have captured about 30% of the total volume during recent years, largely as a result of sharply lower price."

An announcement by Crucible Steel Co. of America, the only other domestic producer of drill steel, takes note of the current situation and says:

"Early in 1960, Crucible Steel, confronted with the problem of rising costs and foreign competition, made the decision to put up a fight.

"For 50 years we have made hollow drill steel. We have the capacity to



A FAVORITE FOR CONSTRUCTION, MINING AND MILITARY surveys. The reading system, fully illuminated, features a scale microscope direct to 1′ and better than 20″ by estimation. Repetitions are made with a circle clamp, eliminating upper and lower motions. Simple operation and reading, ruggedness, and highest Wild precision in optics and mechanics combine to make the T-16 your best choice in this type instrument...by far!

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WILD T-16
OPTICAL TRANSIT
Available with erecting image telescope
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One of a *complete* line of superb instruments for Surveying, Photogrammetry and Microscopy. *Write for Booklet T-16.*

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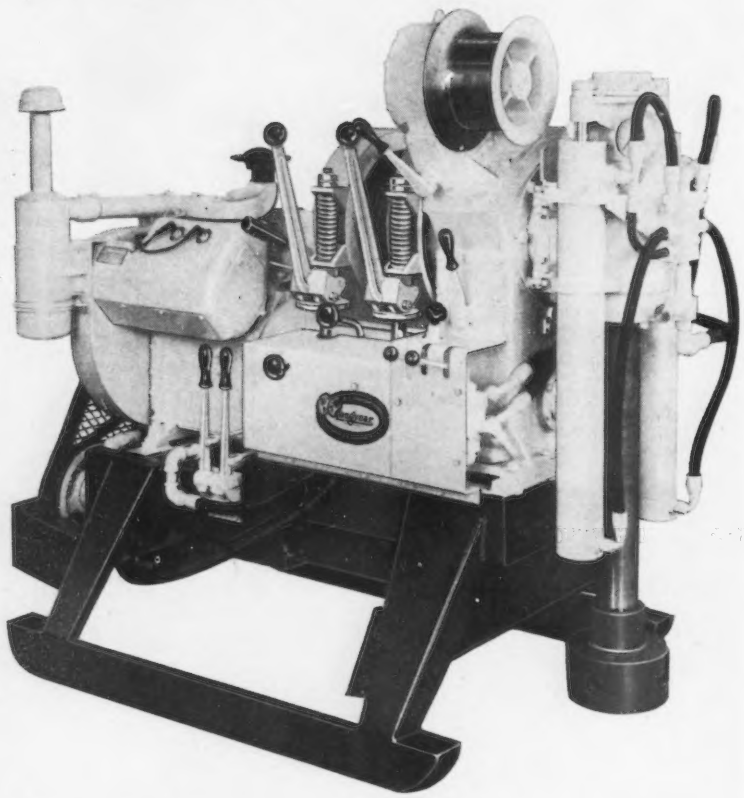
IT'S A FACT*



*NEW Longyear "38" Drill works anywhere, goes anywhere . . .

NOW LONGYEAR OFFERS YOU a compact, heavy-duty Diamond Drill that combines all the features drillers have asked for. The new Model "38" opens an era of operating efficiency on all kinds of mineral exploration jobs, blast hole drilling and site development work. Check the tested features below and see for yourself why the "38" is truly a modern drill built for modern drilling techniques.

- **NEW OPERATING EASE**—Control-Center Design provides "finger-tip" grouping of controls. No lost operating time or backaches from inefficient control arrangement.
- **NEW VERSATILITY**—Available with angle hole mast, hydraulic retraction equipment, built-in wire line hoist, high-speed chuck runback and variable volume hydraulic system. Gasoline, diesel, air or electric drive.
- **NEW COMPACT SIZE**—Takes less space, transports easier with light-weight chassis breakdown. Low center of gravity gives greater safety whether used on skids, truck or trailer.
- **NEW DRILLING SPEEDS**—Rugged 3-inch head with 8 spindle speeds rotates large diameter rods. Special low-range for rotating casing or rock bitting. Capacity is full 2800 feet with AW rods.

For complete information, contact our nearest office.

A1001

Longyear **E. J. LONGYEAR COMPANY**
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Tokyo, Japan

Drill Steel (*Continued*)

supply all the demand for hollow drill steel in the U.S. . . . We are currently making an investment in new equipment to maintain the quality of hollow drill steel. . ."

Canadian and Swedish steel manufacturers have been cited as the major sources of imported drill steel.

Assessment Work on Claims Deadline is September 1st

LEGAL REQUIREMENTS for assessment work on unpatented claims must be completed or underway by Sept. 1, 1961 for protection of claim.

The period for doing $100 worth of work (it can be geological, geophysical or geochemical for up to two years in a row) was changed from July 1 to July to Sept. 1 to Sept. 1 in 1958, and remains in force.

A claim owner need not complete the work before Sept. 1, 1961 provided such work is under way at that time. The Bureau of Land Management notes that such work, if extending beyond Sept. 1, can be continued for a $200 investment — thus qualifying the claim for next year as well.

Cominco $20-Million Boost Awaits Okay on Railway

CONSOLIDATED MINING AND SMELTING Co. will begin a $20-million expansion of activity in the Great Slave Lake area and at Trail, B.C., as soon as the federal government passes legislation to build the railway which will extend from the Northern Alberta Railway to Pine Point.

W. S. Kirkpatrick, president of Cominco, said that, with the opening of the vast lead-zinc deposits at Great Slave, his firm expected to find it necessary to boost capacity at Trail by 15%. He noted that if the decision to build had not been forthcoming, Cominco would have had to look for alternative sources of concentrates.

Transport minister Leon Balcer is introducing legislation for the railway during this session of Parliament at Ottawa.

AEC Eyes Four Remaining Uranium Mill Contracts

ONLY FOUR MILLING CONTRACTS within the domestic uranium industry remain to be extended into the 1962-1966 procurement period, according to Allan E. Jones, general manager of the AEC's Grand Junction Operations Office.

And these contracts will be whipped together this summer. The contracts include: Vitro Chemical Co. (Vitro Corporation of America) mill at Salt Lake

AMSCO Simplex . . . best by test

Simplex Tips handle twice the tonnage of former make teeth in North Carolina Quarry . . . without reversing

Digging is rough in a North Carolina limestone quarry and shovel tooth wear is a real problem. To solve this wear problem several sets of a competitive 2-part teeth were tried. The shovel handled six to seven thousand tons during the life of these tips. Two sets of Amsco Simplex were also tested in the same pit, on the same shovel. The first set of Simplex tips dug 12,445 tons *without being reversed.* The second dug 13,920 tons *without reversing.* Twice the tonnage of competitive teeth tested. In addition the owner stated that the Simplex teeth had a better fit between the adapter and dipper and it took less time to change tips.

If you are experiencing costly dipper tooth wear, order a set of Amsco Simplex Teeth and we think you will find them "best by test." If you don't know your nearest Amsco dealer, write us, and we'll send you his address plus a copy of Amsco's Buyer's Guide for Simplex Teeth.

Amsco Cast Manganese Steel Dippers

You can be sure of long and dependable service even under the most abusive conditions when you specify an Amsco Cast Manganese Steel Dipper for a new or used shovel. Sizes from ¾ to 12 cu. yd.

AMSCO

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILLINOIS

AMERICAN Brake Shoe

Other plants in:
Denver • Los Angeles • New Castle, Delaware
Oakland, California • St. Louis
in Canada: Joliette Steel and Manitoba Steel Foundry Divisions
in Mexico: Amsco Mexicana, S.A.

261

Mill Contracts (*Continued*)

City; Homestake New Mexico Partners' mill, Grants. N.M.; Rare Metals Corporation of America (El Paso Natural Gas Co.), Tuba City, Ariz.; Edgemont, S.D. mill of Susquehanna Western Corp. Listed as "inactive" at present are the negotiations which have been carried on with a Caspar, Wyo. minerals firm covering constuction of a 600 tpd mill at Bowman, N.D. which would process uraniferous lignites into 1500 tons U308.

The Commission also announced that for fiscal year beginning July 1, 1961, it expects to purchase yellow cake from domestic sources as follows:

State	Tons	Value
Arizona	275	$ 5,500,000
Colorado	2,850	47,800,000
New Mexico	7,875	124,000,000
North Dakota	240	4,300,000
South Dakota	170	3,200,000
Utah	3,050	52,300,000
Washington	280	5,100,000
Wyoming	2,895	47,100,000

R. M. Parsons Buys Anaconda-Jurden

ANACONDA-JURDEN ASSOCIATES, INC., previously the engineering and industrial design subsidiary of The Anaconda Co., has been purchased by Ralph M. Parsons Co., Los Angeles engineering and construction firm. The Parsons-Jurden Corp., as the newly acquired firm will be called, has operated internationally in design and construction of mining, milling, smelting and metallurgical plants. In addition to offering these services to the metals industries, the Parsons-Jurden

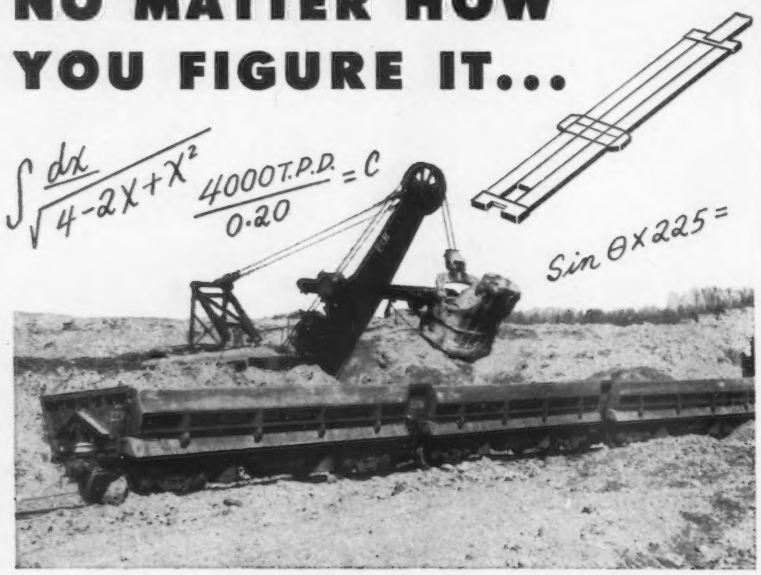
Ralph M. Parsons

Wilbur Jurden

Corp. will expand its work to include nuclear, missile, petroleum refinery and chemical plant engineering and construction by the addition of personnel from Parsons' Los Angeles headquarters.

The company will retain its old offices at 26 Broadway in New York. Wilbur Jurden, previously president of Anaconda-Jurden, will continue as president of Parsons-Jurden.

NO MATTER HOW YOU FIGURE IT...



Differential AIR DUMP CARS come up with lowest overall haulage costs...

Contributing to these low costs are such Differential features as:

1. Most favorable live load ratio without sacrifice of strength.
2. Simplicity of design producing least maintenance cost.
3. Quick, clean dumping.
4. Inherent high degree of safety.

Since 1915
Pioneers in Haulage Equipment

DIFFERENTIAL
STEEL CAR COMPANY
FINDLAY, OHIO

IN THE U.S.

ARIZONA

Magma Copper Co. has acquired the Belmont Copper Mining property near Superior, for $800,000 with option to reconvey the property or to make payment by Jan. 1, 1976.

The Belmont property is two miles southeast of Superior and consists of 120 unpatented and 12 patented claims which adjoin the Queen Creek mining claims on which Magma took a 12-year option to purchase for $375,000 in 1958. Both properties cover 3½ square miles.

Belmont has been a main source of water supply for Superior.

CALIFORNIA

The Iron Exploration Co. of Bunker Hill Co. is now in the midst of a diamond drill investigation of the Shasta Iron deposits, near Redding, Shasta County.

The company represents a joint exploration venture between Bunker Hill Mining, W. R. Grace and Co., Morrison and Knudsen, Inc. and Hydrocarbon Research, Inc.

Four California businessmen are staking $20,000 in gold placer operation on a secluded 40-acre site in Bouquet Canyon, near Saugus. If preliminary estimates come true, the combine could recover $2,000 worth of gold a day, nearly half the total gold recovered in Los Angeles County in 1959.

What does CARSET really mean?

Sure it's a trademark for an Ingersoll-Rand rock bit with tungsten carbide cutting edges. But...it also means years of know-how...the experience born of thousands of trials...and frustrations... and hundreds of thousands of dollars spent in searching and perfecting.

It also means selection...and rejection of more materials and shapes and sizes and what have you...than we care to talk about.

It means steadfastness, against experts from without...and from within. It also means criticism from the bargain hunters and die-hards with the do-it-yourself kits.

In short, it means we will continue to give you the best bit that know-how and money can build. If you have not already standardized on the bit that is backed by experience and everything you need for drilling rock...do it now.

A CONSTANT STANDARD
OF QUALITY
IN EVERYTHING YOU NEED
FOR DRILLING ROCK

Ingersoll-Rand®
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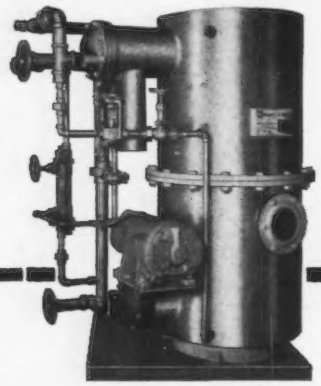
FRESH WATER

FUEL-FREE TO DIESEL OWNERS



Wherever there is a diesel and a source of salt or brackish water, fresh water exceeding U.S. Public Health Service requirements can be made simply and at low cost with an AMF-Maxim Aquavap heat recovery evaporator. These evaporators, operating on engine jacket water or any other hot water source, add nothing to existing fuel costs. They are low in initial cost, inexpensive to maintain and simple to operate. They are delivered as complete packaged units, ready to install, and are extremely compact. A 1000 gallons per day Aquavap, for example, is less than 4 feet high and takes laterally about 2 x 4 feet of floor or deck space. Aquavaps are available with capacities ranging from 150 to 12,500 gallons per day.

For further details write Dept. M for the new illustrated Aquavap Bulletin.

AMF MAXIM EVAPORATOR DIVISION
American Machine & Foundry Company
WATERFORD, CONN. • Branch, DENVER, COLO.

FLORIDA

International Minerals & Chemicals Corp. will invest $3.8-million in an expansion program at its Bonnie plant. The program will add diammonium phosphate to the IMC line of fertilizer ingredients which already includes triple superphosphate, phosphoric acid, feed phosphates and sulphuric acid.

The 100,000-ton capacity addition is due in October, according to president Thomas M. Ware.

IDAHO

An optimistic report for the first quarter of 1961 and a prediction that the next four years will be on a par with the company's highly successful 1960 operations were presented by Henry L. Day, president and manager of Day Mines, Inc., at the company's recent annual meeting in Wallace. The firm reported an operating net of $502,000 in the first quarter of 1960. Day Mines holds a 25% operating interest in the rich Asarco Galena silver property in North Idaho and also owns the Gold Dollar gold property in Ferry County, Wash.

Bunker Hill Co. is tunneling westerly in the Crescent mine during the course of its regular development, Roger H. McConnel, chief geologist, reported in Kellogg. The Crescent, located west of the Sunshine mine in the silver belt of North Idaho, is currently yielding about 3200 tons of silver-copper ore monthly between the 2800 and 3100 level, McConnel said.

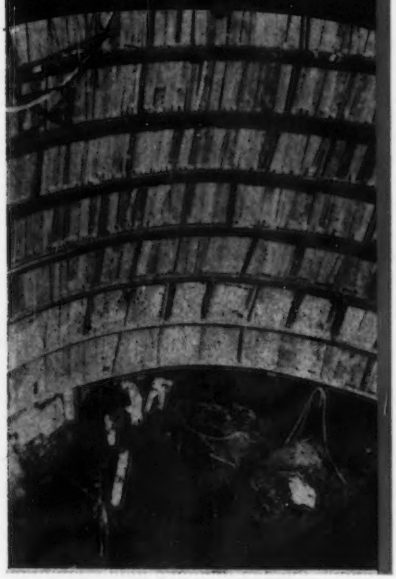
The shaft at the Conjecture mine at the south end of Lake Pend Oreille in northern Idaho is now below 1800 ft and is being deepened at the rate of 9 ft a day. Crews are working on a three-shift basis, 24 hours a day, seven days a week. Deepening of the shaft from the 1000-ft level to the 2000-ft level was started this spring by Federal Resources Corp., Salt Lake City, under a profit sharing agreement with Conjecture Mines, Inc., Spokane. Officials expect the project at the silver-lead-zinc mine to be completed later this summer.

May 31 wrote "finis" to Asarco lease operation of the historic old Jack Waite mine, a lead-zinc producer in the Murray area north of Wallace. On that date the company formally turned the mine and surface plants back to the Jack Waite Mining Co. The mine came into existence shortly after the turn of the century and has been a steady, though not large producer, through the years. Current low prices of lead-zinc prompted the move.

Gold mining operations were expected to begin in early July in the Florence Basin by Idaho Mining & Milling, Inc., which installed Pan American jigs on its 2000 cubic yd Yuba dredge at the site. The firm also operates a Bodinson dragline dredge (2000 cubic yd per day capacity).

Arrangements have been made for 40,000 gal fuel storage tanks.

MISSILE SILO EXCAVATION Stabilized by Halliburton Pressure Grouting!



THIS MISSILE LAUNCHING SITE, a hard-type underground Silo installation, is located in an area plagued by a deep crust of unconsolidated gravel and sand. Facing the problem of excavating a vertical wall for this site, the contractor called upon Halliburton Company for Pressure Grouting Service to help consolidate the loose soil. After 51 grouting holes were drilled around the perimeter of the site and the pipe was cemented, Halliburton placed its revolutionary new **HERCULOX** grouting fluid into the formation, stabilizing the loose gravel and sand. By perforating the pipe with Halliburton's jet shaped-charges, the grouting chemical was selectively placed opposite the offending formation.

HERCULOX is a permanent, hard setting water-base resin material, chemically unmatched for its strength and economy. The near-water viscosity of **HERCULOX** allows it to penetrate even fine unconsolidated and some consolidated sands *at low pumping pressures!*

HERCULOX can be custom-tailored to specific temperature and depth requirements. It sets satisfactorily at temperatures as low as 65°F., building to a 1,500 psi compressive strength *in a matter of only a few hours.* In applications such as running water shut-off, **HERCULOX** may be accelerated for even faster setting time.

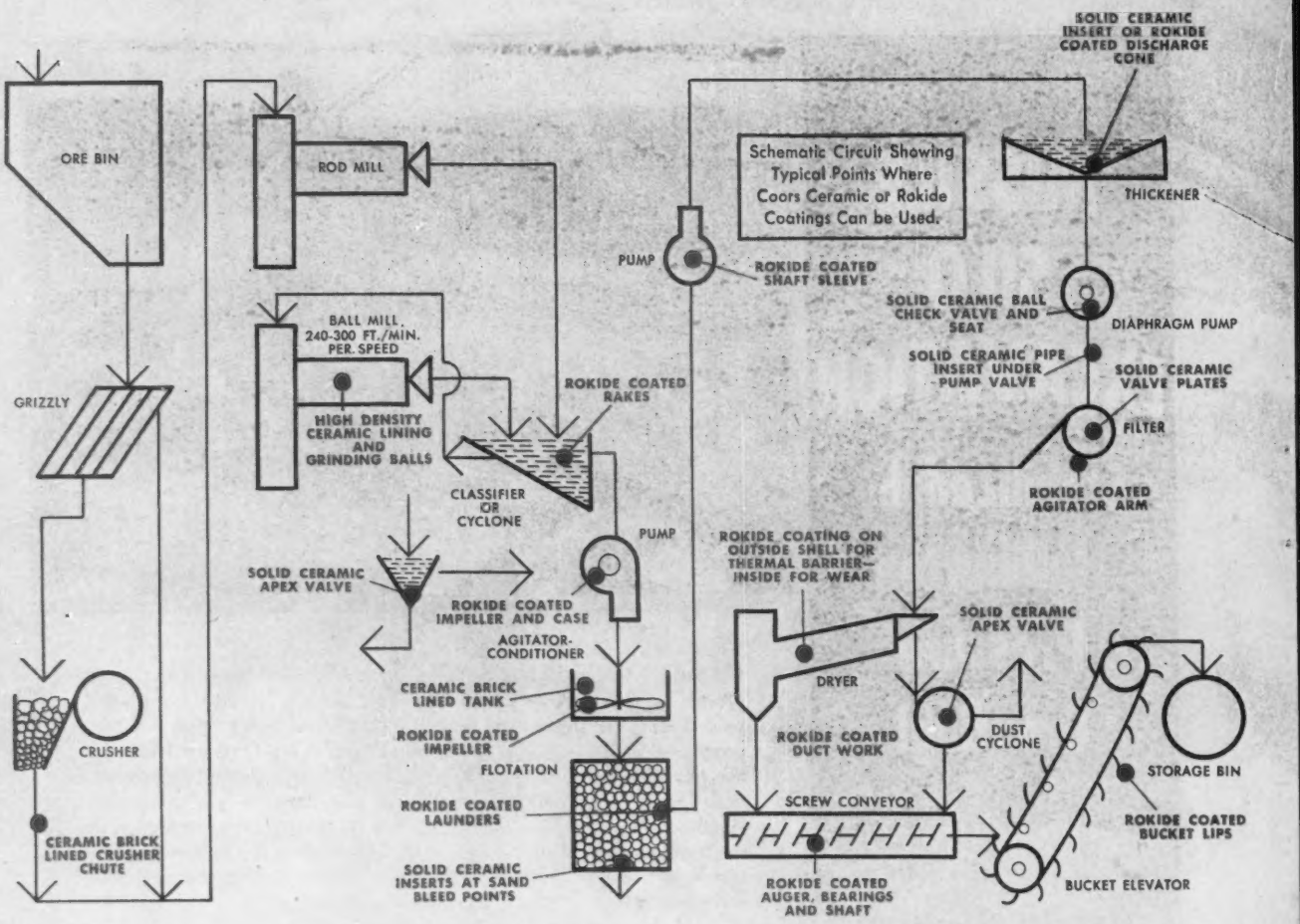
IN ADDITION TO **HERCULOX**, Halliburton provides other chemical grouting fluids, including HYDRO-LOK (PWG), HYDRO-LOK (HG-10), and BLOX-ALL . . . each designed to perform specific jobs depending upon underground conditions encountered in the advancing technology of pressure grouting.

For *best results* in soil consolidation and underground water control, discuss your problem with a HALLIBURTON PRESSURE GROUTING ENGINEER.

PRESSURE GROUTING SERVICES

HALLIBURTON IS FULLY QUALIFIED TO PERFORM ANY SIZE GROUTING JOB AS A PRIME OR SUB-CONTRACTOR

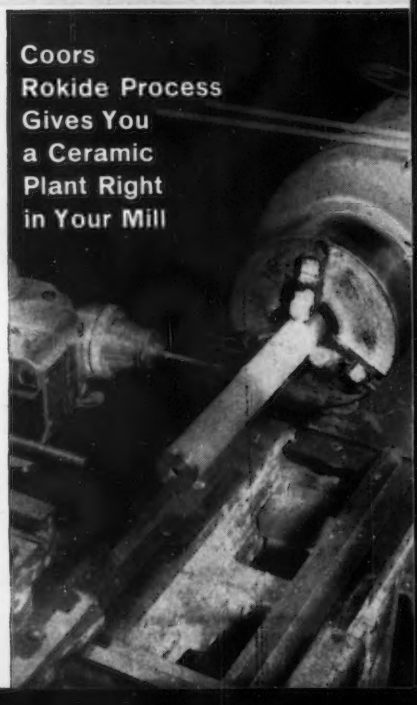
Halliburton
COMPANY . DUNCAN, OKLAHOMA



ALSO: MECHANICAL PUMP SEALS; MULLER WHEELS AND PLATE; METERING ORIFICES

Solve Wear and Corrosion Problems

Critical wear and corrosion points in your circuit can be protected with Coors high strength ceramic parts or coatings. Solid ceramic parts are sapphire hard (Rockwell 45N 75-81), and strong (over 30,000 psi Tensile Strength, over 350,000 psi Compressive Strength)—providing high resistance to wear and abrasion. The ceramic is virtually inert to chemical attack. Rokide ceramic spray coatings have many of the advantages of the solid ceramic parts. Take a look around your mill and see if Coors Ceramics can help you solve critical wear and corrosion problems. Write for Data Sheet 0001 giving properties of solid ceramic parts—Data Sheet 9000 for Rokide coatings. *Coors supplies solid ceramic lining bricks and grinding balls. Most solid ceramic parts can be ordered through your equipment manufacturer. Coors offers process licenses and material so you can do Rokide coating right in your mill.*



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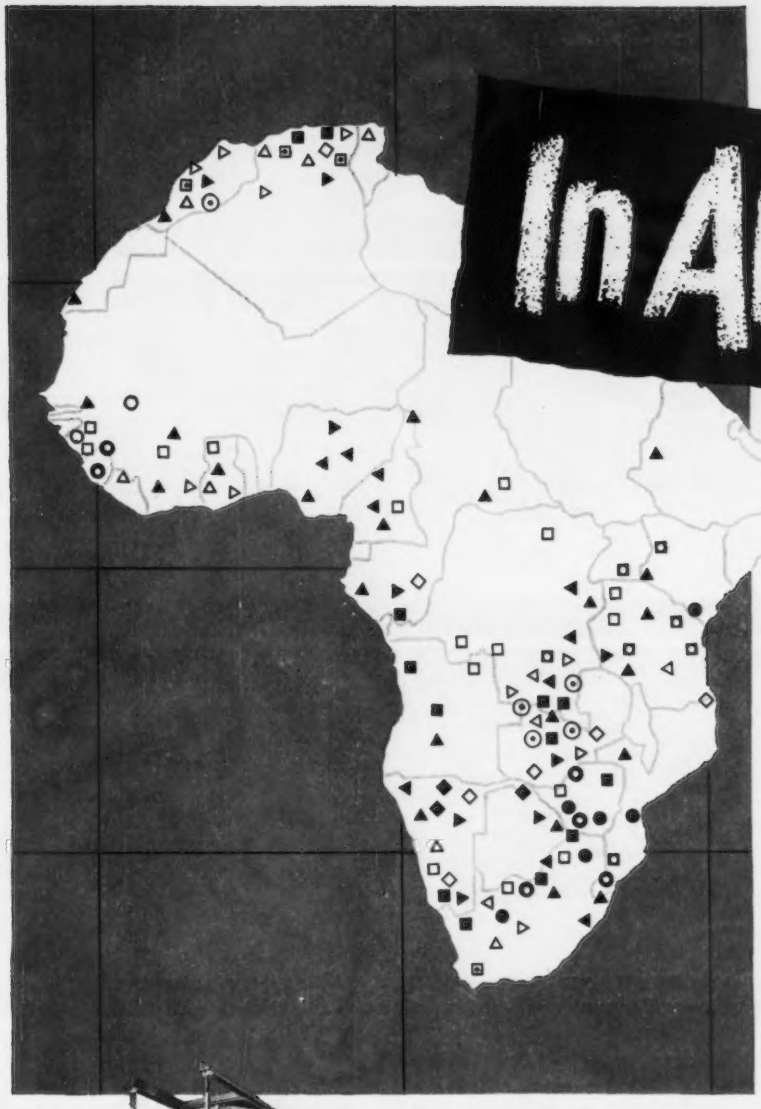


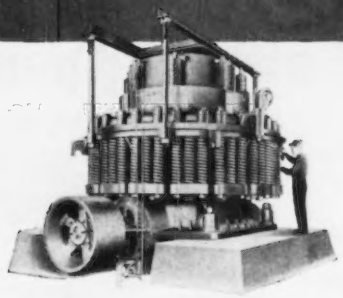
...SYMONS® CONE CRUSHERS

used for efficient reduction of ores and minerals

(Partial list of Africa's ores and minerals. Symbols indicate location of important deposits.)

● ASBESTOS	▶ LEAD
○ BAUXITE	▷ MANGANESE
◎ CHROMIUM	◘ MICA
⊙ COBALT	▣ PHOSPHATES
■ COPPER	◀ TIN
□ DIAMONDS	◁ URANIUM
▲ GOLD	◆ VANADIUM
△ IRON	◇ ZINC

. . . as well as aggregates, cement rock, gravel, etc., for the construction industry.



SYMONS CONE CRUSHERS
. . . *The machines that revolutionized crushing practice* . . . are built in a wide range of sizes, for capacities to over 1500 tons per hour. Write for descriptive literature.

In all of the great ore and mineral operations around the world . . . there has been no record to equal the performance of Symons Cone Crushers in consistently and efficiently producing great quantities of finely crushed product at low cost.

In Africa, hundreds of Symons Cones are used by leading producers of most of the ores and minerals found in this giant continent. As an indication of its mineral wealth, it is significant to note that Africa produces almost 75% of the world's cobalt, 65% of its gold, 50% of its antimony, 33% of its manganese, chrome and phosphates, 25% of its copper, 15% of its lead and tin, a large part of its uranium and practically all of its diamonds.

The use of Symons Cone Crushers in Africa is another example of the way in which these efficient crushers serve the mining and mineral processing industries of the world.

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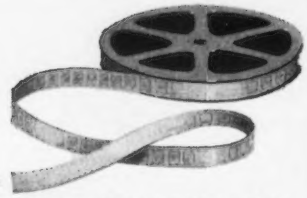
ACTION FILM* SHOWS HOW

KW-DART 55T tandem axles roll with road punch!

These action photos show how the 55T's triple-reduction planetary drive axles *take* road shock, absorb it, and come back for more.

The KW-DART 55T has been proved in use by operators throughout the world for *years*. It hauls 55 tons per cycle with maximum speed and safety. Its rugged tandem axles give extra stability and traction over pits and ruts and changing grades. Its single 600-700 H.P. power train delivers payload after payload—with minimum maintenance and downtime.

KW-DART rock and ore movers are *custom-engineered* to meet the haulage requirements of *your* particular job. They have earned their reputation for giving a long, trouble-free service life. Dependable, job-proved KW-DART end dump trucks can boost your production, aid your scheduling, and cut your costs.



*

FREE 16MM COLOR FILM AVAILABLE TO MINING AND CONSTRUCTION COMPANIES UPON REQUEST

Prove to yourself, by viewing these action shots, that the KW-DART 55T is designed, engineered and constructed to do your job *better*. Drop us a line on your letterhead. Your print will be sent by return mail. There is no obligation, of course.

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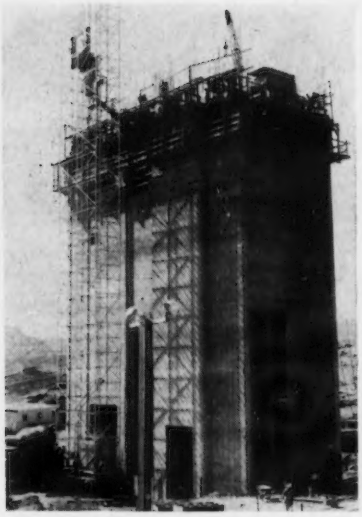
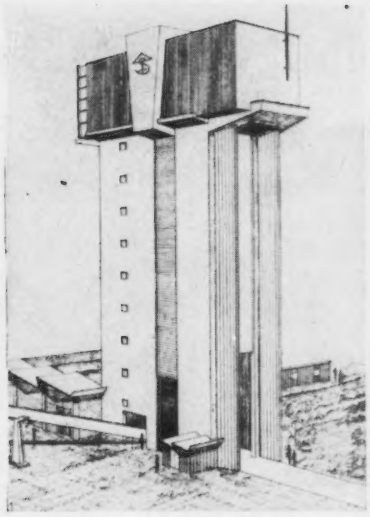




THE ALL-CONCRETE HEADFRAME on the new $30-million potash mining project is nearly completed at Cane Creek, Utah. A 2800-ft shaft will be sunk.

Texas Gulf Completing Headframe; Potash Shaft Will Start Down Soon

STEARNS-ROGER MANUFACTURING CO., Dever, is completing an "equivalent" to a 19-story office building for the mining of potash ore at 2800 foot depth.

The unique headframe at the $30-million Texas Gulf Sulphur Co.'s Cane Creek, Grand County, Utah project—single largest potash producer in US—is in process of completion.

Stearns-Roger, which has contract for surface plant installation, including 1.1-million ton-a-year muriate of potash beneficiation unit, is now adding the steel enclosed unit for protection of hoisting machinery.

The headframe, unlike the conventional steel girder headframes common in Western Hemisphere mining, is constructed of reinforced concrete. With the upper steel enclosure, it will stand some 185 ft above the shaft collar and will measure 32 ft in length and 40 ft in width at hoist deck level (near surface.)

Concrete walls of the giant structure were built by slip forming, a construction method involving raising of wall forms by electrical jacks at a continuous rate. Concrete segment of the headframe was started on May 8 and required about 9½ days of continuous pouring of concrete for its completion.

About 3,000 cubic yards of concrete and 180 tons of reinforcing steel are in the structure. Presently, the concrete part of the hoisting headframe is 123 feet above the ground and will be finished off—with addition of the upper steel enclosure—at 168 ft above surface.

Contiguous to headframe structure will be changehouse and other facilities for the miners as well as headquarters for the mine superintendent.

Ore hoisting machinery will be powered by electrical motors totalling 3500 hp. They will be capable of hoisting more than ten tons per minute of potash ore over the 2800 ft distance from surface to shaft bottom. This represents one of the fastest lifting rates in U.S. mining.

Collar of the mine shaft, down about 80 ft, was completed by Stearns-Roger without encountering water of any sort although the project is on banks of the Colorado River about nine miles southwest of the uranium mining town of Moab.

Harrison International will commence sinking of the 22-ft concrete lined, divided, circular shaft as soon as hoisting equipment is installed in the headframe. Meanwhile, Denver & Rio Grande Western Railroad Co. will call for bids for construction of 39 mile branch from its main line to the potash project in June. This will involve driving of a 7000 ft tunnel through limestone section.

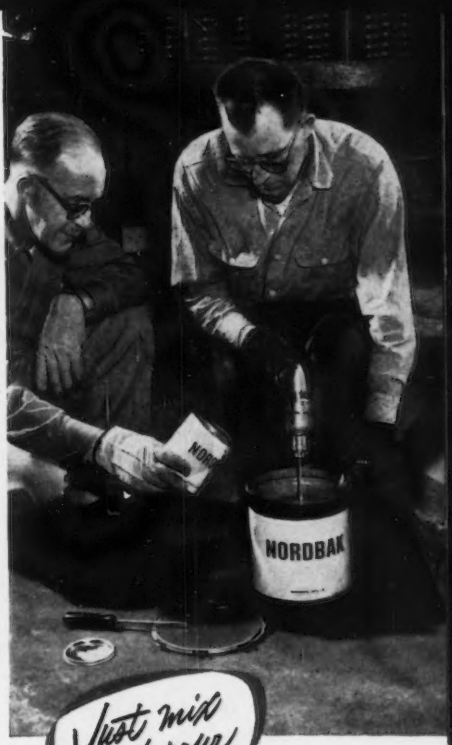
Ore grade of Cane Creek deposit is plus 25% K20 compared with average grade of around 18% K20 in New Mexico fields.

MONTANA

A new project at the Kelley Mine and a build-up of the Leonard Mine force are increasing employment in Butte.

E. I. Renouard, Anaconda Co. vice president on June 7 said the company has added about 175 miners and others to the Butte payroll in recent weeks. About 50 more contract miners will be needed in the near future.

Twenty to thirty contract miners will be employed at the Kelley in a new stope mining project, the executive said.



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Tough, Resilient, Non-Metallic

Here it is! NORDBAK . . . the manganese backing you pour at "room temperature." You simply mix the contents of two cans together and pour!

Field tests and on-the-job experience show that NORDBAK really works! Because it's resilient and non-shrinking, it provides excellent backing. It's so tough that in a prolonged test the manganese wore through in spots, but NORDBAK remained uncracked. It's easily removed at changeout, too. You can store NORDBAK at your operations . . . get a supply to keep on hand, ready for the next time you replace liners.

Call, wire or write your order for NORDBAK!

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N461-1/3

NORDBERG MFG. CO.

Milwaukee 1, Wisconsin

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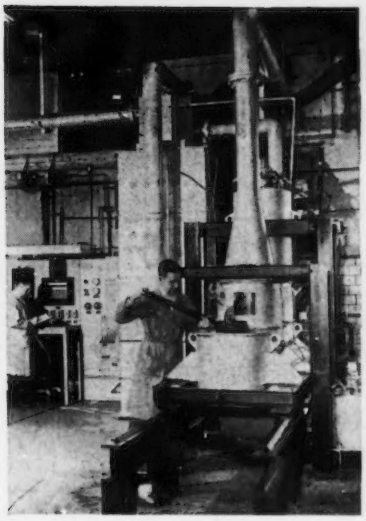

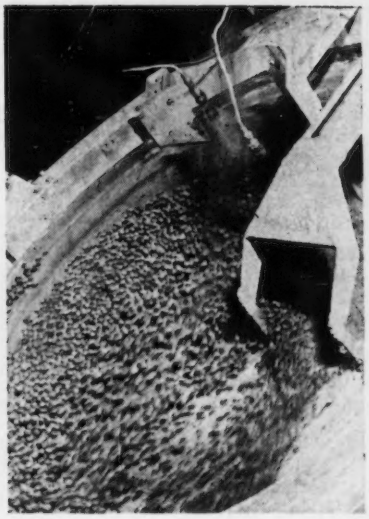

ALL PARTS of a traveling grate pelletizing plant are scaled to fit laboratory conditions. Green pellets for various tests are formed on Dravo-Lurgi disk.

New Dravo Lab Studies Iron Pelletizing

DRAVO CORP. has added a new department to its already extensive research center on Neville Island, near Pittsburgh, and will now study all aspects of iron ore pelletizing. The new facility, Dravo said, represents the latest in laboratory test equipment and was desgined by company engineers to approximate actual plant conditions for various types of agglomeration processes and to furnish information from which full-scale plant requirements can be determined.

Dravo is the American licensee of the Lurgi Co., Frankfurt, Germany, for design and construction of plants adapting these processes, and can draw heavily on the results of Lurgi's extensive research and development work.

All of the new center's new equipment must be as flexible and controllable as possible. Material flow duplicates that in an actual operating plant, with feed preparation—grinding, filtering and pellet formation—followed by pellet firing, cooling and testing: These things Dravo carries out in the following mobile apparatus:

1. A grinding mill, which can be operated as either a ball or rod mill and can use either the wet or dry grinding process;
2. Filter for mositure control;
3. Charging or discharge station, where the refractory-lined steel batch vessel is filled and empties;
4. Up-draft station where air is blown through the fired pellets for cooking;
5. Down-draft combustion chamber, used for either firing or drying pellets.—room temperatures to 3000°F can be maintained;
6. Heat exchanger for pre-heating combustion air—approximates plant operation;
7. Instrument panel which indicates air pressure, air flow, exhaust gas flow, suction, and firing temperature. The temperature recorder has 12 thermo-couples for readings at any point in the process.

Typical iron ore pellet charge would consist of 170 lb of green pellets, 50 lb of hearth layer and 50 lb of side layer. Green pellets are prepared on a standard Dravo-Lurgi pelletizing disk or in a balling drum.

Several series of tests have been performed to establish the correlation between results from the new facility and operating plant experience. Dravo said that from data acquired, research engineers can scale up to full-size design requirements with no difficulty.

Montana (*Continued*)

The project involves the mining of remnant veins adjacent to the Kelley block cave mining area. Leonard Mine authorizations are now employing about 150 men. It is expected this number will be increased to 200 or more by the end of the year and to more than 300 early in 1962 when Leonard production is scheduled to reach 1000 tons per day.

Reopening of the Leonard Mine, which has been closed since June 1958, started in March with a force of about a dozen men. Since then about 400 ft of the shaft has been retimbered, ventilation and other services re-established and work is now proceeding to prepare for stope mining.

The Leonard is being reactivated at least two years sooner than had been planned under the deep level mining program. The present Leonard project is to mine ore between the 1300 and 2000-ft levels and tram it at the existing 1600 and 2000 levels to the Kelley mine for hoisting.

Deeper zones in the Leonard will be mined later in the program, which is to see the Kelley No. 1 as the central hoist-

Just mix and pour

NORDBAK

It's Simple, Safe and Sure...

It had to happen . . . someone was bound to find a way to end the problems of backing manganese crusher parts with molten metal!

Now . . . you can do it with NORDBAK!

It's mixed at "room temperature" and poured right from a can into the crusher cavities. Gone is the need for special melting and pouring equipment . . . and gone are the hazards of pouring hot metal.

An initial, low cost order to back one set of crusher parts will prove the many advantages of NORDBAK *. . . call, write or wire your order today!*

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N261-1/3R

NORDBERG MFG. CO.

Milwaukee 1, Wisconsin

LUBE LOGIC

New tips for more efficient maintenance

Don't let storage tank contaminate gasoline

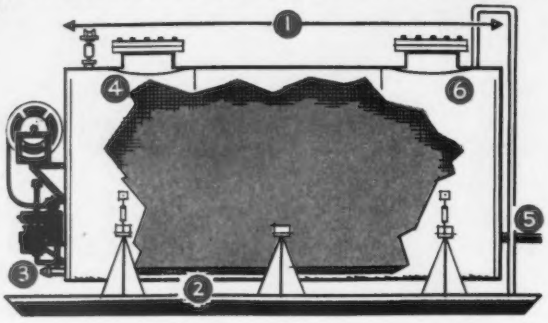
One of the basic essentials of good equipment performance is clean fuel; and the best way to make sure the fuel you use is as clean as the fuel you buy is to keep your own storage facilities up to snuff.

What does it take to make the ideal gasoline storage tank? Here are some of the specifics that Texaco engineers have found to be most important.

The ideal gasoline storage tank has:

1. Plenty of room. Every time you fill a tank you stir up the sediment at the bottom. The bigger the tank, the less it has to be refilled, and the longer the sediment stays settled on the bottom.

2. Welded construction.



3. A 1½" drain valve, located at the lowest point.

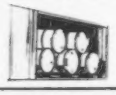
4. A large hand hole plate or manhole, to make cleaning easier.

5. A suction line to the gasoline pump located several inches above the tank bottom, to avoid drawing out the sediment and condensate.

6. A fine-mesh strainer over the filler opening.

Four tips to keep hydraulic oil clean in storage and handling

Even the best maintenance techniques won't keep your hydraulic equipment on the move if you don't keep the oil clean while it's in storage and while it's being put into the machine. Here are four simple precautions that will assure you of getting nothing but clean, clear oil in the hydraulic system:



1. Store the drums on their sides, indoors if possible, but in any event under some sort of shelter.

2. Before you open a drum, clean the top so that no dirt or water can fall into the oil.

3. Make sure that you use only *clean* hose and containers in transferring the oil from the drum to the equipment.

4. Filter the oil as it enters the reservoir on the machine. If the fill pipe on the equipment doesn't have a filter, use a funnel fitted with a 200-mesh screen.

Protect diesel fuel injector with periodic tank drains

Dirt and water in diesel fuel can ruin a fuel injector in no time. Even if you keep the fuel clean during storage, there's still a good chance that temperature changes will create enough condensation in the fuel tank on your rig to start rusting in the injectors. Several operators have pretty well solved this problem by partially draining the fuel tank once or twice a week. Simply draw off about a gallon of fluid through the drain valve at the bottom of the fuel tank. You lose some fuel this way, but you also get the accumulated water and other contaminants clear out of the fuel system. The cost of the fuel you drain off is a small loss compared to the repair bills you save on the fuel injectors.

TEXACO LUBRICATION ENGINEERS

Every month or so we'll bring you a batch of "sleepers," little angles, so easy to overlook, where big savings in money and time can be made. If Lube Logic doesn't solve your problem, call your local Texaco Lubrication Engineer. Anytime, all the time, he's your best source of money-saving lubrication ideas. Don't forget that "Lubrication is a major factor in cost control." Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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Throughout the United States

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Montana (*Continued*)

ing shaft for high grade ore from deep levels of the Mountain Con, Steward and Leonard Mines.

Eventually the Belmont Mine, which has been closed since November 1956, may be reactivated and tied into the Kelley deep level system.

Renouard said the company is seeking more vein type copper ore in the Kelley and Leonard projects to add to the present production from the Mountain Con and Steward vein line. The ore is needed to maintain a satisfactory mill-feed grade for the concentrator at Anaconda. Use of more vein ore also will extend the life of the low-grade mining operations Renouard said.

Development work on the multi-million dollar deep level mining program is proceeding on schedule. Hoisting of high-grade ore from the deep levels through the Kelley shaft is expected to start by 1964.

Vermilion Gold, Inc., Spokane, announced plans to drill test holes at a gold placer property in the Vermilion River area of western Montana. The firm has completed a caisson sinking project at the site.

Frank H. Duvall and Frank D. Duvall, both of Spokane, are operating the property and head the family-owned company. They said the caisson method was used for sinking six circular shafts to depths of 12 to 20 ft.

Spokane National Mines, Inc., Spokane, has made its first shipment of ore from the New Departure mine at Bannack. The 20-ton shipment went to a smelter at East Helena. Ore was mined from a drift being driven from Pit No. 2 on a new vein that appears to be running more than 200 oz of silver per ton over a width of 2 ft. The ore also includes some gold, copper and lead.

Bunker Hill Co., Kellogg, signed a 25-year lease on June 15 with Nancy Lee Mines, Inc., Kellogg, covering Nancy Lee's promising lead-sliver-copper mine near Superior.

Lester Harrison, vice president of Nancy Lee, said that Bunker Hill will take over operation of the Montana mine if the agreement is approved by Nancy Lee stockholders at a forthcoming meeting.

Under terms of the lease, Bunker Hill will deepen the Nancy Lee shaft 400 ft from the present 790-ft bottom.

President Delbrook Lichtenberg and secretary Don B. Bennett of Bozeman, have announced the formation of a new mining company.

The new firm, Ruby Gold Inc., is wholly owned by Gold Reserve. The new firm will acquire all of Gold Reserve's mining interests in the Little Rockies near Zortman.

The Ruby claims about 2000 acres are composed mainly of gold and silver ores. The property has produced several million dollars worth of ore since the early 1900's.

The office of the Secretary of State, Helena, announced issuance of a Montana charter to Pioneer Exploration Co., Inc., Butte. The mining firm listed authorized capital at $100,000.

The charter allows the holders to acquire, hold, work and operate mines and lodes of gold, silver, and other associated minerals. The incorporators are Joseph G. Klapan, John F. Ransom, and Joseph T. Farrow, all of Butte.

NEVADA

Anaconda Co. must seek a new source of sulphur for its Yerington copper mill after this year, according to company officials. The Leviathan mine, just over the line in California, has been furnishing sulphur for the Anaconda mill in Lyon County ever since that operation began, but the Leviathan is now nearing exhaustion, and 1961 is expected to be its last year of operation. The sulphur is used for manufacturing sulphuric acid needed for leaching the oxide copper ores.

White Caps Mining Co. is producing ore from the True Blue mine near Austin following a recently completed rehabilitation program. Values are in silver and lead. Some re-timbering was done in the old mine, pipe lines were installed, and air vents established. Samples from the mine have showed good assays. White Caps has announced plans to seek Federal assistance, under the plan recently set up by Secretary Udall, in order to finance development of its White Caps mine in Manhattan, and of its beryllium deposits in Owens Valley.

Stockholders of Goldfield Consolidated Mines Co. voted down a proposal to merge with Getchell Mine Inc. at their meeting in May. Goldfield Consolidated acquired 42% of Getchell Mine stock in 1960 and is presently developing the Getchell Mine in Humboldt County. The vote by the stockholders is not expected to influence the plans for operation of the mine in the near future.

William Dial, of Carson City, is operating a recently developed iron mine east of the state capital on the Ormsby-Douglas county line. A magnetic separation plant has been set up at the site, and regular shipments of high grade magnetite are being made. Mining is proceeding at the rate of 800 tpd and the ore is trucked to Wabuska where it is loaded on railroad cars.

NORTH CAROLINA

Stockholders of the Cranberry Magnetite Corp. of Cranberry, N. C. voted to increase the capital stock by $100,000 and elected four new directors, Dr. Claude Frazier of Asheville, N. T. Dixon of Cranberry, Joel Dimmette of Lenoir, and Ervin Rust of Charlotte.

The company has drilled a mile-and-a-quarter tunnel through the orebody and has a plant which will concentrate the ore into a minus one-fourth inch product containing 62% iron and a fine-ground product containing 70% iron.

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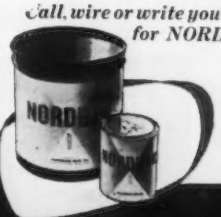
It's the modern, effective way to back manganese

Non-metallic NORDBAK streamlines crushing operations of every kind. It's as easy to use out in the field as it is in the plant. You mix it and pour it right on the job...*wherever* your crusher is. No need for special melting or pouring equipment.

NORDBAK fills extremely narrow voids and is only ¼ the weight of metallic backing agents. Conveniently packaged, NORDBAK is *the one* modern, effective backing agent for manganese crusher parts!

You can use NORDBAK in ALL TYPES of crushers, grinding mills and other machinery where backing agents are required.

Call, wire or write your order for NORDBAK!



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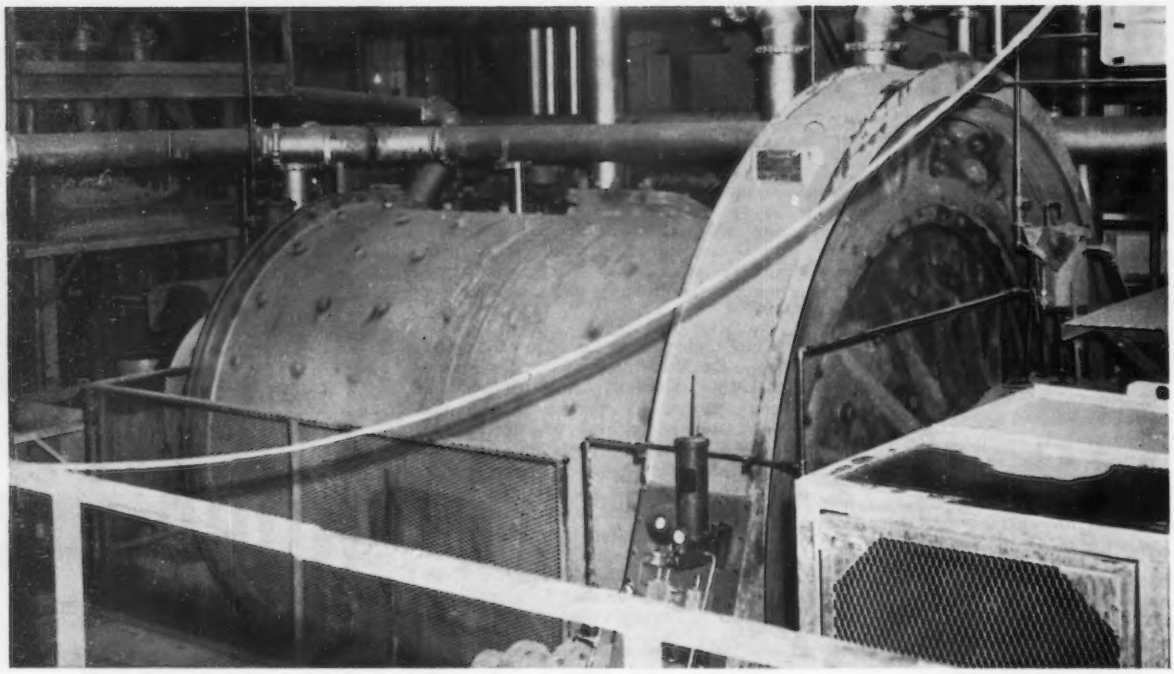
N361-1/3-R2

NORDBERG MFG. CO.

Milwaukee 1, Wisconsin

Anaconda Selects Marcy Mills for its modernization program



One of three new 9′ x 14′ Marcy Ball Mills at Anaconda

Photo courtesy Mining World.

Anaconda Reduction Works, Anaconda, Montana, has an extensive modernization program to improve metallurgical results and reduce costs.

This program includes a regrind stage on rougher flotation concentrates and the company selected three 9′ x 14′ Marcy Ball Mills for the job.

Anaconda Has Purchased More Than 70 Marcy Mills

During the past 30 years Anaconda and its subsidiaries have purchased a total of more than 70 Marcy Ball and Rod Mills . . . evidence of the efficient and economical operation of Marcy Mills.

We want a chance to ask **YOU** for **YOUR** order . . . by having an opportunity to show you how **YOU** can improve metallurgy and reduce costs with Marcy Mills. We invite your inquiry by letter, wire or phone.

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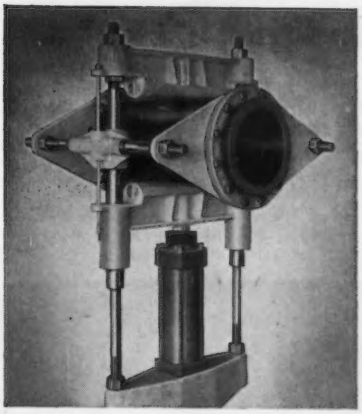

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Hydral-60
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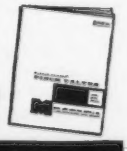
- Hydraulic pump may be operated by electric motor or by air from normal plant supply system.
- Valves may be the same or different size.
- Valves in the system may be operated simultaneously or independently.
- Control valve may be manual or solenoid.
- Valves may be coordinated and interlocked with other plant equipment to automatically control tank levels, rate of flow, etc.
- Valves are self-supporting and may be operated in any position from horizontal to vertical.
- Valves may be independently controlled for normal or rapid closure.
- Valves may be held fully open, fully closed, or at intermediate positions.
- Remote control to meet individual requirements.
- Controls may be included for automatic emergency operation.
- 3" to 14" I.D. sizes, with 50, 100, and 150 psi line pressure ratings.
- Temperatures to 200° F.



WRITE FOR NEW CATALOG NO. 609

Manufacturing Division

MINE AND SMELTER SUPPLY CO.

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OFFICES AND AGENTS IN PRINCIPAL CITIES

UTAH

Standard Metals Co., Moab, has closed all of its properties "until such time as the price situation in lead and zinc improves," according to W. R. McCormick.

He said that Standard needed approval by Congress and the Administration of legislation on lead and zinc sponsored by Rep. Wayne Aspinall (D. Colo.) "so we can compete with foreign imports and realize a return on a $2-million investment" in the Sunnyside, Colo., (American Tunnel) project.

He said there was no ore being produced at Sunnyside and that recently renovated and expanded mill at the property had been closed. Standard some time ago closed down its Crested Buttes, Colo., mines and mill.

United Park City Mines Co. has encountered what may be an important, new high grade lead-silver-zinc discovery at its Park City, properties.

S. K. Droubay, vice president and general manager, said that the ore trend is in the Humbug formation (limestones) below a thick section of quartzite. This area, also, is below the historic producing area in the Jenney formation which in past days of operations by the Daly Mining Co. and Judge Mining Co. (later-Daly-Judge) produced some 4-million tons of high grade ore.

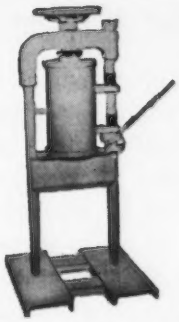
UPC has encountered one of a series of fissures in the Humbug formation from which 150 tons have been mined, averaging $50 a ton with silver running 16 to 17 oz a ton and combined lead and zinc, 24%. In the Jenney formation, up above, the fissures bedded out into the major producing zones. Mr. Droubay said that UPC was fanning out with cross cut and extensive drilling program to confirm not only ore zones in other fissures but bedding of the ore out from those fissures.

WASHINGTON

Pend Oreille Mines and Metals Co., Spokane, has been able to reduce exploration and development costs at the Pend Oreille mine near Metaline Falls, by use of long-hole drilling, president Jens Jensen told a stockholders' meeting. Long-hole drilling has been substituted for diamond drilling. He said the long-hole drilling costs have been about 37¢ a ft compared with $2.80 a ft for diamond drilling.

Jensen also told the meeting the ore reserves of zinc and lead in the Metaline mining district have been estimated at $3-billion, of which more than half are owned by Pend Oreille.

Gold Bug Mining Co., Spokane, has started development of a gold-copper-silver property near Danville, in Ferry County. Officials said the property is at the south end of a mineralized belt which includes the old Granby mine across the border in British Columbia. The property is the old Mineral Hill site. An old tunnel at the property is being rehabilitated.



MINIMIZE FILTERING TIME WITH THE BOOTH PRESSURE SAMPLE FILTER

Unlike most pressure sample filters, it does not require the tightening of two screws before applying air pressure, thus making it unexcelled for speed and convenience. It is closed by simply swinging barrel and yoke into place and rotating hand wheel. When open, free access is given to barrel and base. All parts line up automatically. Write today for Bulletin No. 566 giving further information.

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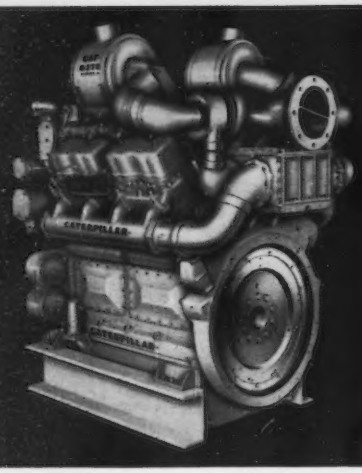
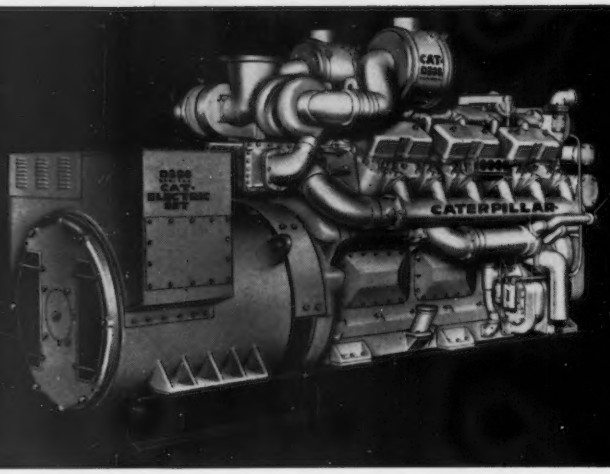
new Cat D398-D379



Cat D379 Industrial Engine. The 6.25" bore, 8.00" stroke D379 and D398 both offer the latest in attachments including marine gears and generators. The D379 Electric Set develops up to 350 KW continuous, 400 KW standby.



Cat D398 Electric Set. The D398 Electric Set shown here with Static-Regulated, Static-Excited Generator features a new generator with built-in static excitation system with no exciter generator or vibrating parts. Develops 500 KW continuous, 600 KW standby.

Give more horsepower per pound, per dollar than any other industrial engine in their class

The V12 D398 and the V8 D379 are rated at 950 and 630 maximum HP, respectively. Electric set versions reach to 600 and 400 KW. Marine ratings exceed 1000 HP. These engines are now available at prices that are less than crankshaft replacement prices of some competitive engines in their class.

Published list prices show the D398 to be thousands of dollars less than the next lowest priced industrial engine that will develop comparable horsepower. Other advantages are quality aluminum alloy bearings, aluminum pistons with cast-iron ring band for top two compression rings, drop forged-dynamically balanced crankshaft and high strength rigid block. These engines save in space and weight, too . . . with at least 35-40% less size and 4800 pounds less weight than other makes with comparable horsepower.

Here are more reasons why Cat D398 and D379 Diesels and Electric Sets give you extra value

NEW PERFORMANCE STANDARDS

- Turbocharged-Aftercooled design
- Static-Regulated, Static-Excited Cat Generators
- High flow lube and water systems
- Ability to burn wide range of fuels

NEW ENGINE FLEXIBILITY

- 100% HP from either end of engines
- Six available accessory drives – up to 50 HP each
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- Standard (counterclockwise) rotation or opposite rotation

NEW SERVICE EASE

- Fuel or lube filters serviced from either side
- Remove heads without disturbing manifolding
- Easily inspect or remove pistons, rods and bearings through large side ports
- Externally mounted oil pumps for easy inspection and maintenance

For complete specifications on the D398 and D379 Diesel Engines or Electric Sets, contact your Caterpillar Dealer or Caterpillar Engine Division, Peoria, Illinois.

CATERPILLAR

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Caterpillar Tractor Co., Engine Division, Peoria, Illinois, U. S. A.

Washington (*Continued*)

Rare Metals Corp. of America, Salt Lake City, a subsidiary of El Paso Natural Gas Co., has acquired a lease and option from Red Top Mining Co., Colville, on the old Red Top lead-zinc-silver mine near Leadpoint.

About $15,000 worth of exploration work is planned by the firm during the next two years. Rare Metals plans to drive a 500-ft tunnel about 150 ft below the present main adit in order to tap at a greater depth a shoot of high grade ore that was being mined in 1958.

Goldfield Consolidated Mines Co. said it is closing the Anderson mine at Leadpoint because of low lead and zinc prices. The firm had recently completed the second stage of a big development program at the property. A 950-ft haulage route was driven on a 10% grade from the bottom of the open pit mine. Officials said a new orebody found by drifting and raising at the property can be mined by open pit methods. The underground openings were driven in low grade ore and the firm stockpiled about 20,000 tons at the nearby mill site. The firm has postponed construction plans for a 1000 tpd mill because of low metal prices.

WYOMING

A resolution asking the American Mining Congress to support a move to have 90% of all mineral royalties on Federal land returned to the state has been adopted by the Wyoming Mining Association board of directors.

Most western states now get 37½% returned to the states.

Other resolutions adopted by the board of directors asked the American Mining Congress to support the Wyoming group's opposition to Federal water power projects, such as the Bruns Creek project planned on Snake River in eastern Idaho.

The Wyoming association also asked support to maintain 25% gold behind all money and to allow transfer of uranium allocations from one property to another.

IN CANADA

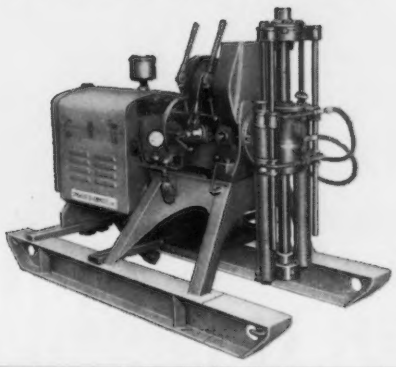
BRITISH COLUMBIA

Wenner-Gren interests, with financing from New York and Toronto, are launching a further search for minerals over 40% of British Columbia.

Wenner-Gren Explorations Ltd., an Ontario company formed to carry this out, expects to spend about $400,000 this year in exploration work, most of it in northern British Columbia.

The company has taken over the mining interests previously held by Wenner-Gren B. C. Development Company. Ronald B. McCartney managing director, reports from Toronto it has present financing of $1-million from an American group.

"THIS IS THE BEST MACHINE FOR MOST CORE DRILLING JOBS"



IT'S AN S&H MODEL 40-CL

We've heard this phrase over and over again from our many customers. They know that it is unsurpassed for foundation investigation, mineral exploration, and grout hole drilling.

THIS IS WHY THEY BOUGHT A 40-CL

- STABILITY — Wider, longer skids and a sturdy steel frame make it very difficult to tip even when moving in mountainous terrain.
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- ADAPTABILITY — The choice of . . . power units, screwfeed or hydraulic swivelheads in varying spindle sizes, four transmission speeds and the availability of a side-mounted cathead and a built-in retracting mechanism makes the 40-CL adaptable to most drilling jobs.
- MOBILITY — The 40-CL has a built-in set of sheaves to facilitate movement under its own power. In addition a low-bed trailer is available that permits the use of the rig directly from the trailer mounting in locations where the terrain permits.
- QUALITY — Careful machining and time-tested inspection methods substantially increase the trouble-free drill life.

If you want a machine for truck mounting, ask about our 40-C TRUCK-MOUNT. When you want an "all-round" core drill machine, remember that the 40-C and 40-CL Core Drills are just the machines for you.

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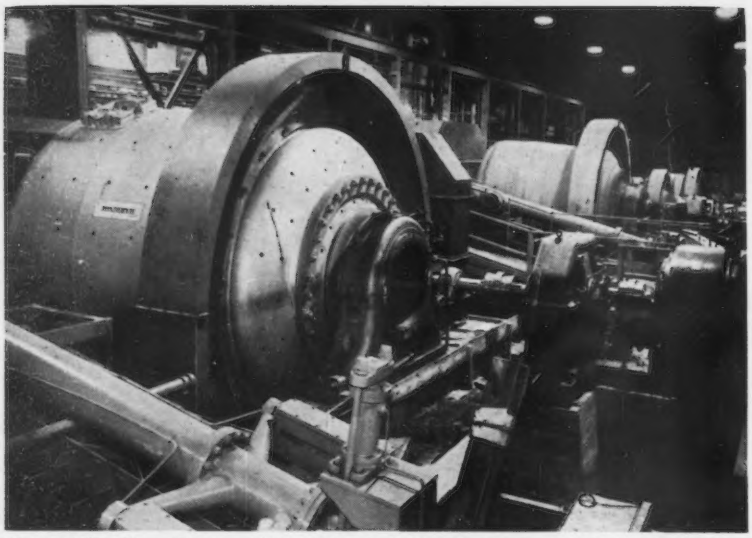
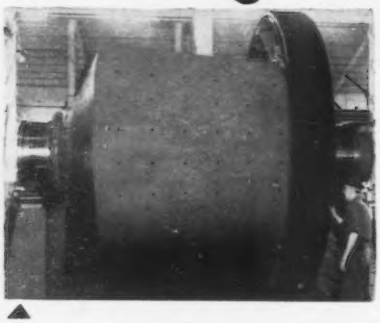


11-3-6-10 Hardinge Tricone Mills in the Grinding Department of Opemiska Copper Mines, Ltd. Two Hardinge 8′ x 72″ Conical Mills can be seen in the background.

CORRECT BALL SEGREGATION in the Hardinge* TRICONE MILLS

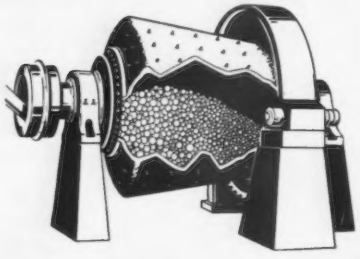


Shop view of a 10½′ Tricone with 9′ long tapered shell.

Highest grinding efficiency and lowest ball and lining wear are common to mills with a correctly segregated ball charge. The Hardinge Tricone Mill is the only mill providing these essentials to low cost operation without the use of special linings or internal devices, which are subject to wear and are effective through only a part of their wearing life.

The Tricone also occupies less floor space for its grinding volume than any other ball mill built.

Every ball in the Hardinge Tricone Mill "minds its own business!"



Complete specifications upon request. Bulletin AH-414-1

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B.C. (*Continued*)

Mining and stockpiling at the Craigmont Mines Ltd. property near Merritt is speeding up. At May 1, the company had stockpiled 111,400 tons of low grade ore and 6,600 tons of normal grade.

Negotiations are being conducted for sale of copper concentrates.

Equipment delivery and construction are proceeding. Ball and rod mills and flotation cells are in place, crusher foundation and steel work are nearing completion and fine ore bins are taking shape.

NOVA SCOTIA

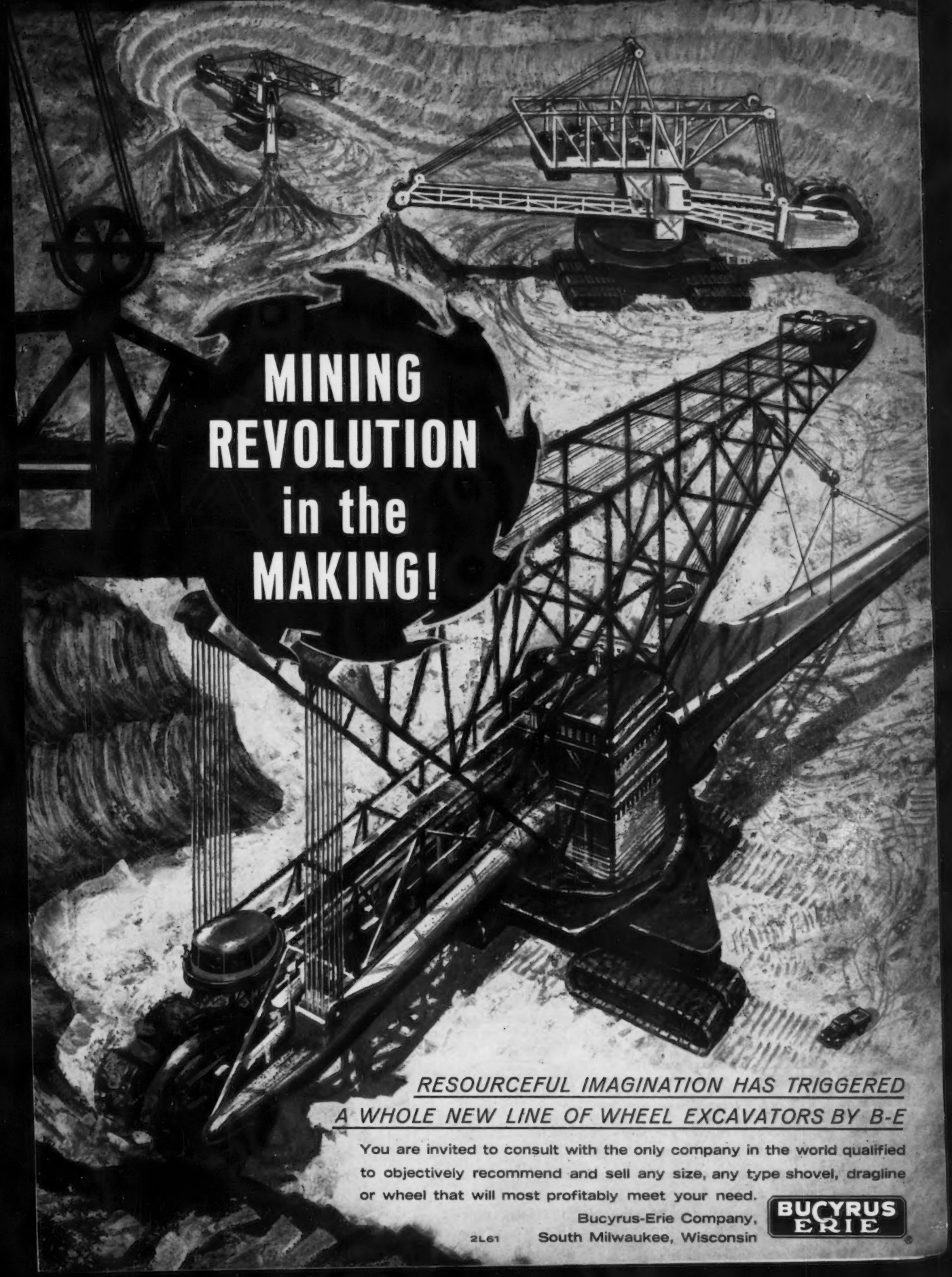
Over a dozen Canadian mining companies have acquired ground in the vicinity of the Magnet Cove Barium Corp. property in the Walton area. The latter, a barites producer, is currently preparing to open a rich and sizable silver-lead orebody, which was discovered in diamond drilling from its present mine workings. Production is planned in the current year. Newcomers in the area include Consolidated Mining & Smelting, Chibougamau Copper Corp., Sogemines Ltd, and Prospectors Airways.

ONTARIO

Cleveland Cliffs Iron Co. has exercised its options on the iron property of Strathagami Mining in the Temagami area. Advance royalty payment is due this year. The minimum contemplated production rate is 1-million tons of iron pellets yearly, and royalties on this basis would amount to at least $450,000 annually. Amount of the advances has not been disclosed. Agreement has been made with the railways providing for a charge of less than $3 per ton of pellets for shipment from the property to steel mills in the Hamilton area.

The Porcupine camp, long famed as a gold producing area, has given birth to a copper producer, its first. Kam-Kotia Porcupine Mines, a subsidiary of Violamac Mines, was brought into production recently and has quickly reached its milling capacity of just over 900 tpd. Mining is by open pit. Drill indicated reserves are estimated at 1,301,000 tons averaging 1.825% copper to depth of 180 ft. in the pit area. Included in this tonnage is 180,700 tons grading 2.675% zinc, and in addition a further 260,000 tons averaging 3.12% zinc has been indicated outside of the main zone, while 882,000 tons averaging 3.672% zinc has been located outside of the pit area. Initially only the copper is being recovered.

Rio Algom Mines is making good progress in shaft deepening at its Pater copper mine in the Elliot Lake district. The shaft is being taken down some 1200 ft from the previous bottom level at 950 ft to open eight new levels. The program is designed to test further depth possibilities.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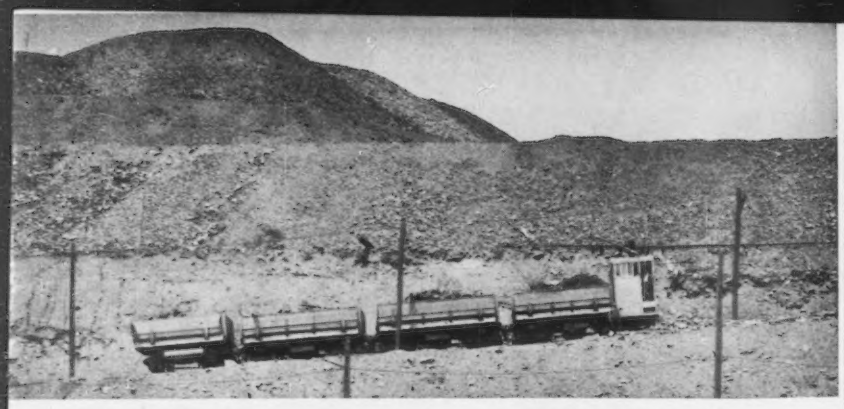

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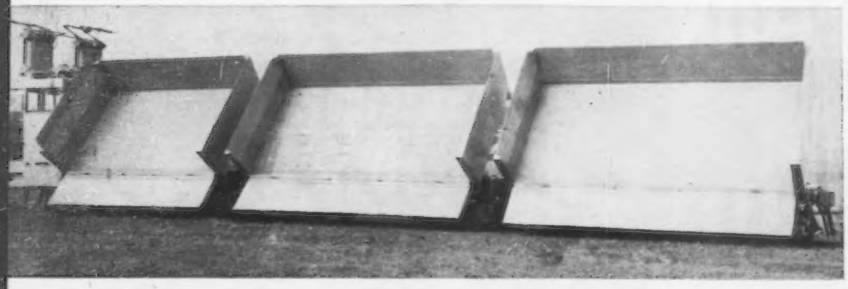
Up and down a 10% grade with DIFFERENTIAL ELECTRIC WHEELS for 13 years without an accident.

Uses trolley for fast climbing up 10% grade. Small auxiliary diesel-electric generator may be used for level track. With steel wheels on steel rails, tractive effort required is 5# per ton on level track, and 205# per ton up 10% grade.

Controlled speed with electric braking down 10% grade. Saves brake shoe and wheel wear. Capacities 1000 HP to 3000 HP.



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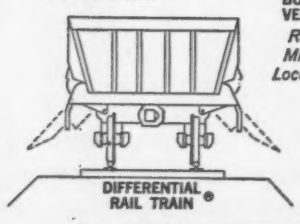

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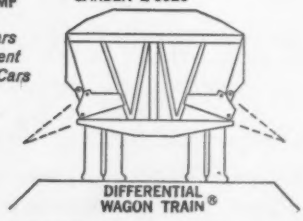


Rent Differential WAGON TRAINS from DIFCO, Findlay, Ohio

Ontario (*Continued*)

Consolidated Vacuum Corp., a subsidiary of Bell & Howell/CEC, will build a large vacuum melting furnace for Eldorado Mining and Refining at a cost of more than $100,000. With the furnace, Eldorado will have completely integrated facilities to process uranium metal into castings of nuclear purity. Capacity is estimated at 3000 to 6000 lb per ingot, with completion expected by early fall at Eldorado's Refinery Division in Port Hope, Ont.

Hedman Mines has resumed work on its chrysotile asbestos property on an expanded scale, beginning with negotiations for land clearance for a new road. Further stripping operations are now underway, using a TD-6 Drott Skid shovel and a D-6 angle dozer, and both are backed up by two trucks which take any suitable material for road fill. In conjunction with these operations, Hedman has purchased a high capacity pump to strip hydraulically wherever possible.

QUEBEC

The best year on record is shaping up for Quebec Iron & Titanium Corp. Demand for titanium slag is at an all-time high, and iron sales, while not so spectacular, are holding up satisfactorily. Slag output is expected to hit 400,000 tons and iron production around 300,000 tons, compared with the previous record of 345,000 tons of slag and 222,000 tons of iron in 1960. Plant and mine expansion programs have been completed in anticipation of new demand.

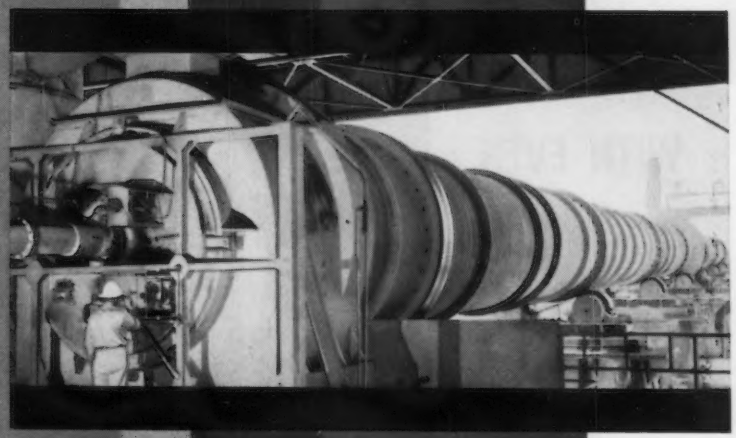
Quebec Lithium Corp. is expanding its lithium refinery in the Val d'Or area. The expansion will provide additional lithium products. The refinery, which is adjacent to the company's lithium mine, started production last October and subsequent results have been sufficiently encouraging to warrant expansion. At present milling operations are averaging around 300 tpd at the 1,000-ton capacity mill.

The Ungava nickel belt in the northern sector of the province would appear to be slated for a new exploration effort following purchase of three favorable tracts recently. Raglan Nickel Mines and Falconbridge were the purchasers.

Wabush Iron Co., eye-ing full production by 1965, received some new partners to push its large-scale iron ore mining development in Labrador. The new participants are another Canadian steel producer, Dominion Foundries and Steel of Hamilton, Ont., Finsider of Rome, Italy and two West German companies whose names have not been disclosed pending final negotiations. At the same time Kaiser of Canada has taken on the design and construction of a beneficiating plant.

Wabush ownership already includes the Steel Co. of Canada, Youngstown Sheet and Tube, Interlaken Iron Corp., Inland Steel Co. and Pickands Mather & Co. which is also the managing agent.

TRAYLOR FIRST



Why this 1933 first welded kiln could be the key to your company's profits in the 60's

For the simple well-proved reason that they're better, kilns of all-welded construction are pretty much "standard" today. Important to keep in mind: the standard was set by Traylor . . . builder of the first welded kiln in 1933.

A radical innovation a generation ago —but why so important now? First and obviously, it means that Traylor has the longest record of experience in this special kind of equipment.

More important still: It's merely one example of Traylor's coming up first with new ideas to meet changing needs. Benefits of other Traylor "firsts"—some dating before 1933, many since—are being reaped today throughout the industry, quite likely already including your own plant. Traylor built, for example, the first 60-inch primary gyratory crusher and the first large ball mill.

Today Traylor's proved capacity to pioneer sound innovations in kilns, mills and crushers is enhanced by expanded research capabilities and process know-how.

Up-to-date facilities and a long, impressive record of past "firsts" are a good combination of reasons to call on Traylor first when you're planning for efficient operation in the changing business climate of the sixties.

See Chemical Engineering Catalog for details and specifications.

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EIMCO® 24 RockerShovel® LOADER

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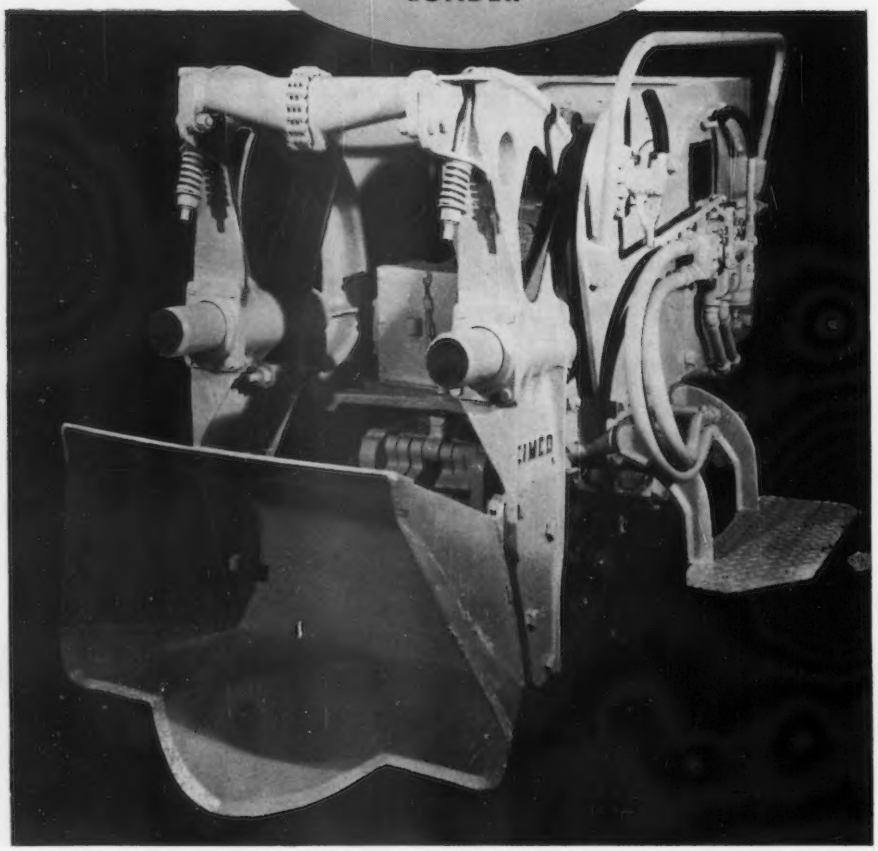

Proud successor to the famous Eimco 21, the new Eimco 24 RockerShovel Loader will load longer cars, will load faster and last far longer than any other loader of comparable size and cost.

One of the many reasons is the patented arrangement of bumper springs in arms, with springs enclosed in cylinder, for trouble-free, long spring life and increased machine stability. Other important features include larger motors - wider cleanup - bigger buckets.

Get all the facts and specifications on the Eimco 24, a loader that incorporates all the knowledge and experience of over 30 years pioneering in the design and production of quality-built underground loaders. Contact your nearby Eimco dealer or branch, or write for Bulletin L-1040-A, containing full specifications and details.

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stops shift shock
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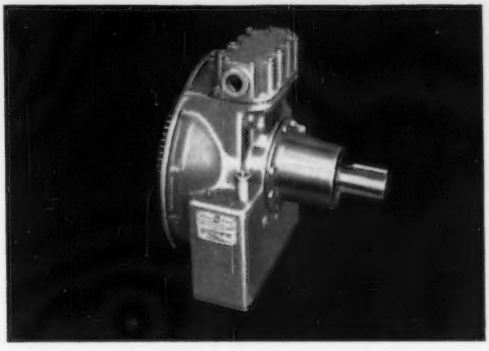
Big reason rolling's so smooth with Galion Roll-O-Matic Drive is its 200-300 Series TORQMATIC Converter. Teamed with a 2-speed transmission, the converter eliminates sudden surges of power, makes it impossible to slip or dwell on the pass.

IN "10-IN-1" MACHINES

Fitted with various "Uni-Tools," the Ottawa Commando can be a truck, crane aerial tower, fork lift, bulldozer, snow plow, power broom, pavement breaker. Allison 200-300 Series TORQMATIC Converters help the Commando do all these jobs smoother, faster, easier.



IN ANY 40-150 H.P. UNIT

With six basic models and 25 different options available, the 200-300 Series TORQMATIC Converters can be used in tractors, ditchers, drilling rigs, cranes, shovels, and other 40-150 h.p. equipment.

Torque multiplication at stall ranges from 2.0 to 3.50, maximum torque input from 200 ft.-lbs. to 350 ft.-lbs., top input speed is 3,000 rpm. Available options include front disconnect clutch and adapter, rear disconnect clutch adapter, chain drive, automotive flange, industrial shaft. Write for the TC 200-300 brochure today.

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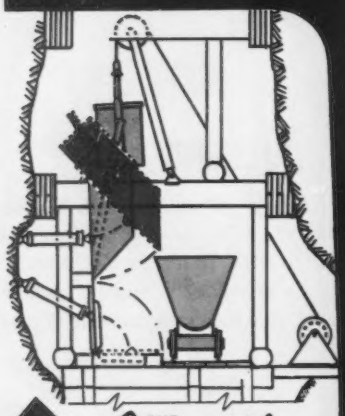

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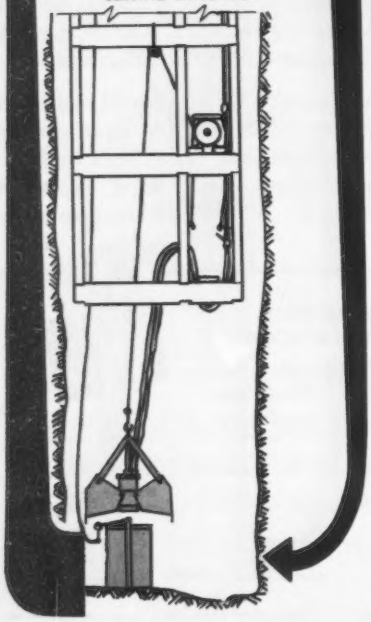

PHILIPPINES

Benguet Consolidated, largest gold producer in the Philippines, had an output of 21,672 in April. Some consideration is being given to an operating agreement with the neighboring Baguio Gold Mining Co., to develop and explore the latter at depth with a deep tunnel now being driven toward the property line. This would be of considerable importance to Baguio Gold which has had an unsuccessful year because of failure to develop new ore, an extra heavy water inflow, and a decline in the gold price on the free market. John C. Curtis is general superintendent of Baguio Gold.

Final Congressional approval has been given to a bill to extend emergency assistance to the gold mining industry, which is badly in need of help. The measure extends price supports to both gold mines and other mines producing gold as a byproduct. Funds would be obtained by tax remission for the mines.

Engineers for the Samar Mining Co. report that the company's iron ore properties in Sibuguey, Zamboanga, should soon be producing 40,000 tons a month. Arrangements have been made to ship about a million tons to Japan, with possibility that 4-million tons may be sent over the next seven years.

The Hope copper gold mine in Davao will increase milling capacity from 250 to 400 tons per day. The property is controlled by Elizalde interests.

Lead deposits in Mt. Province have been reported by roving prospectors near Kibungan, Benguet. If commercial, these could add another metal to Philippine production. Heretofore lead has only been a by-product in gold mining.

Atlas Consolidated shipped concentrates to Japan containing 3,296,000 lb. of copper in April from its Toledo mine in Cebu. Steady progress is being made in improving mine operations in the big Lutopan open pit.

IN LATIN AMERICA

CHILE

A commercial deposit of fluorite has been found near the Mercedes mine about 1 mile S.E. from the village of Paihuano, Coquimbo Province. The mineral is found in veins which cut across a granite batholith and which contain also calcite, galena and topace.

The Under Secretary for mines senor Pistelli has announced that the government will sell in auction or lease the ore deposits found in the northern provinces by the Institute of Geological Investigations. Two geologists from Noranda have been visiting mines in the provinces of Antofagasta and Atacama.

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IN AFRICA

A four year struggle by John A. Hahn and Michael Harris to evolve an economic process for the production of electrolyte manganese from the thousands of dollars worth of manganese wastes pumped daily from South Africa's uranium oxide plants has resulted in a R£1-million export business for the new republic. Using only waste slimes from the West Rand Consolidated (Transvaal) uranium plant as primary raw material, the process is currently producing 2400 tpy.

One of South Africa's oldest gold mines, Simmer and Jack, Johannesburg—operating since 1888—is facing closure and the only hope of prolonging its life for another few years is an increase in the gold price.

In a statement issued to shareholders, the chairman said that the future of the mine cannot be regarded with any great hopes and that it had reached the reclamation stage.

Two other Witwatersrand goldmines, Government Areas and Modder East have already given notice of possible closure and several other mines on Witwatersrand are also approaching the end of their working days.

Since beginning operations Simmer and Jack has mined 14.1-million oz.

Anglovaal Rhodesian Exploration Corp. has cut its activities in the Central African Federation. Half the geologists employed in Rhodesia by Anglovaal have returned to South Africa.

More enquiries from Japanese industrialists for supplies of iron ore from the Rhodesian Federation have revived interest in the many unexploited deposits in the country. Contracts varying from 200,000 to 1.8-million tons per annum of ore grading above 60% iron content have been offered by representatives of Japan's smelting industry.

The Kobe Steel works of Japan is the only concern so far to take up an offer. This company is at present diamond drilling a deposit in Southern Rhodesia and has stated that it will explore the deposit thoroughly and if results are satisfactory export the ore to Japan.

Southern Rhodesia's record mineral output in 1960, worth $73-million, and likely to be exceeded this year, presented an unduly rosy picture of the situation in the mining industry, according to G. H. Parkinson, president of the Chamber of Mines. Parkinson said record figures reflected tonnage mined rather than tonnage sold. Producers were stockpiling at the coast, mainly at Beira, but because ore had been mined, it was listed as production although much of it was still unsold.

Chrome producers, there were 34 in Southern Rhodesia in 1957 and now only 14, could sell their best quality but were having to build up considerable stocks of the lower grades, he said.

Asbestos producers were finding markets for lower grade short fibres but encountered little demand for the better qualities.

Lithium producers had reduced their tonnage but were still stockpiling, Parkinson said.

SUDAN

The Mines and Quarries Board of the Sudan government has invited tenders from international firms to develop the historic Hofrat-en-Nahas Copper mine, in the southern Darfur province, eastern Sudan. The mine is located some 220 miles to the S.W. of Nyala Town and some 200 miles from El Da'ein, the nearest point on the existing Railway System.

IN AUSTRALIA

Mount Isa Mines, Ltd., Australia's largest copper mine, will expand its present 2.5 million ton capacity by sinking a new 1,000 meter shaft. The company has ordered about $3-million worth of equipment from Sweden's electrical engineering company, Asea. This includes a 60-meter steel and concrete shaft tower and three mine hoists of Asea's multirope type. Expansion at the mines, some 600 miles west of Townsville in the Queensland bush, is scheduled for completion in 1964.

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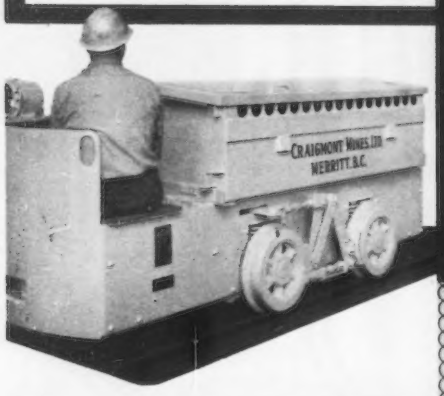

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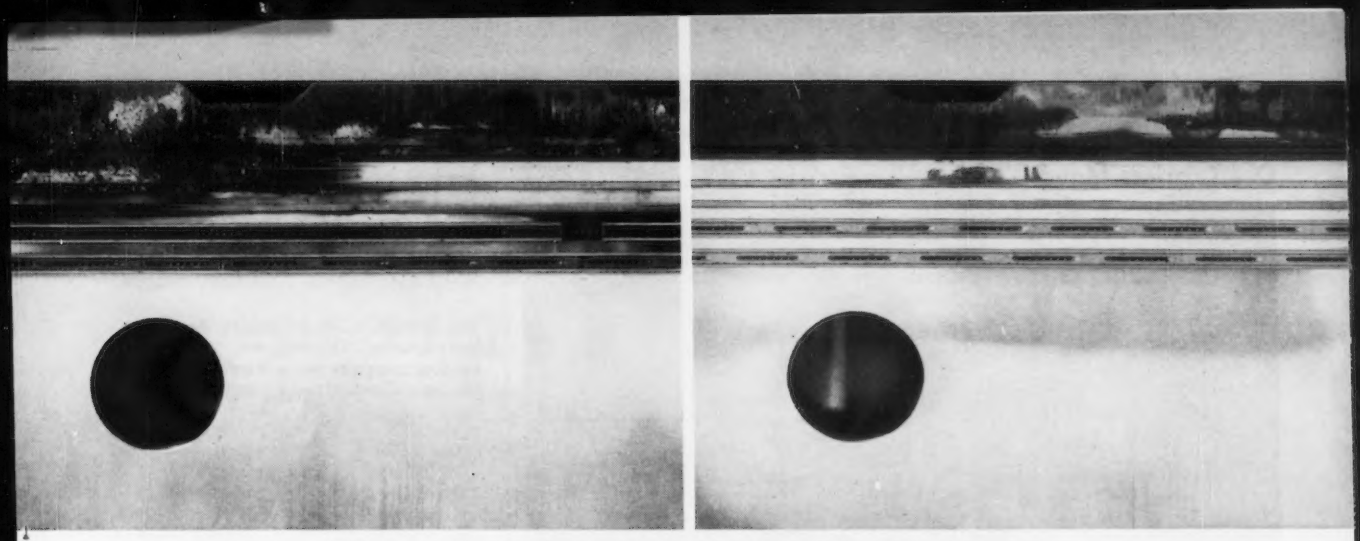

Left: Poor performance of competitive diesel lubricant is easily noted on piston rings.
Right: Superior cleanliness—typical of Shell Rimula Oil performance.

BULLETIN:

Shell reveals how Rimula Oil saved a road construction company $37 per diesel engine on each drain period

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IN THE MIDDLE EAST

EGYPT

The United Arab Republic's Economic Development Organization, the state holding company for a number of mining, metallurgical and chemical industries, has announced it will start several projects in 1962, with a total capital outlay of about $170-million.

Included in the projects are:

1) A third blast furnace with an annual capacity of 150,000 tons to the Iron and Steel Mill at Helwan; Estimated cost: $14-million.

2) Increasing the capacity of Helwan's first blast furnace to 150,000 tons. Both these projects will raise the Iron & Steel Mill's production to 420,000 tons in 1964.

3) Iron Ore Concentration Plant at Aswan, worth $11.2-million;

4) Ferromanganese project ($10-million);

5) Ferrosilicon and calcium carbide project, about 3-million;

EDO's mining companies next year will also start commercial production from zinc and lead deposits at Um Gheig on the Red Sea, estimated at 1-million tons. Zinc extraction is said to be at the rate of 5000 tons per year.

West German experts working for EDO have also found copper ore deposits at Um Sambuki in the Eastern desert, estimated at 2-million tons, and these too may be developed next year.

EDO is also studying the possibility of using the power surplus from the existing Aswan Dam Hydro Station to produce electrolytic aluminum (a project worth nearly $20-million), as well as electrolytic zinc, phosphorous and phosphoric acid.

EDO is also planning to increase iron ore production from its Aswan deposits to 550,000 tons annually, to meet the increased requirements of the Iron & Steel Mill at Helwan.

Meanwhile, according to a report by Riad Hegazi, undersecretary at the Ministry of Industry in Cairo, iron ore deposit estimates in Egypt now total 338-million tons.

The report said West German Krupp technicians working with the Industry Ministry discovered new iron ore deposits in Egypt's Eastern Desert, along the Red Sea Coast.

The report claimed there was enough ore in these eight locations to extract 8500 tons daily for 50 years. The ore samples were sent to the Soviet Union for concentration tests.

Earlier, Soviet technicians working with the Industry Ministry discovered important deposits in the Bahariya Oasis, west of the River Nile. Preliminary analysis of the ore showed there were 45-million tons of 47.9% ore and 100-million tons of 28.2% ore in that area. Ore samples were sent to the Soviet Union for final tests.

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Egypt (*Continued*)

Barium sulphate: deposits were discovered in igneous rocks southeast of Aswan, as well as at Gebel Araf, Wadi Deeb, and Gebel Bakriya in the Eastern Desert.

Ilmenite: New deposits discovered at Abu Dhahr, 170 kilometers south of Mersa Alam, on the Red Sea, had a higher concentration of iron than hitherto discovered in Egypt, the report said. Preliminary estimates put these deposits in hundreds of thousands of tons.

The report also said ilmenite deposits already discovered at Abu Ghalaqa, on the Red Sea, were in the vicinity of 10-million tons, and not four million tons as previously established. Although EDO's General Ilmenite Co. was initially proposing to export the entire output of 100,000 tons annually, EDO is now planning to keep part of the output for local industrialization, in the production of a number of alloys, including ferro-titanium.

Phosphates: In addition to the phosphate mines at Safaga which are now exported as ground and rock phosphate to the Far East and Eastern Europe, new deposits were discovered both east and west of the Nile Valley. Phosphate deposits east of the Nile are said to be between Esna and Edfu and are estimated at 75-million tons, while deposits West of the Nile are at Kharga and Dakhla oases, and are estimated at 100-million tons.

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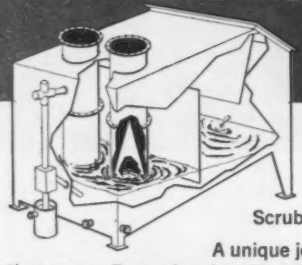

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(Continued from opposite page)

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1—6½" x 7" Hendy Jaw Crusher
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1—20" x 36" Diamond Roller Bearing Jaw Crusher

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1—3' x 8' Marcy Rod Drill
1—4'6" x 4' Hirsch Ball Mill
1—64½ Marcy Ball Mill
1—8' x 22' Hardinge Conical Pebble Mill
1—3' x 7' Morse New Rod Mill
1—5' x 10' Denver Ball-Rod Mill

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1—80 CFM Worthington
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1—100 HP Ingersoll-Rand Imperial Type
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1—F-211 Sullivan Double Drum Air Slusher
1—F-212 Sullivan Double Drum Air Slusher
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1—Gardner-Denver Model HEE
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1—Ingersoll-Rand model HNN-IJ double drum
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13—Sullivan Model E-111
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2—Hardinge 7' x 36" conical pebble mills
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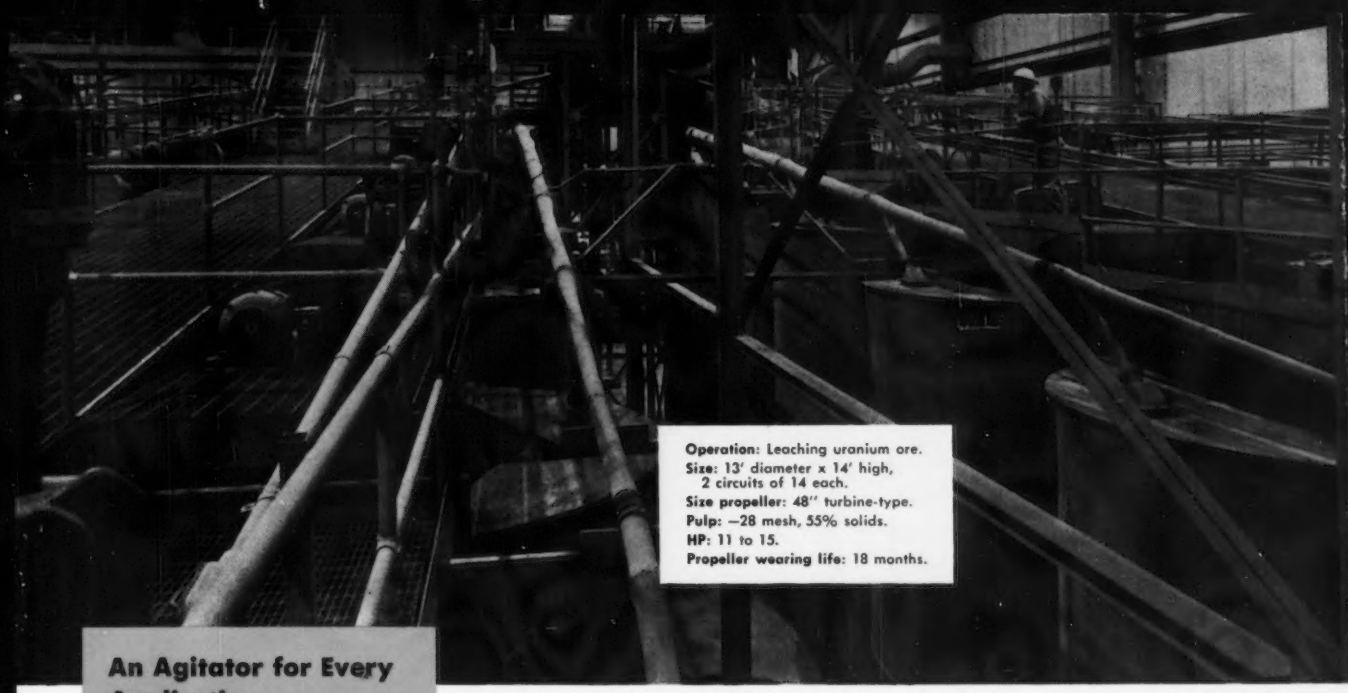


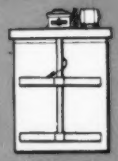
Operation: Leaching uranium ore.
Size: 13′ diameter x 14′ high, 2 circuits of 14 each.
Size propeller: 48″ turbine-type.
Pulp: —28 mesh, 55% solids.
HP: 11 to 15.
Propeller wearing life: 18 months.

An Agitator for Every Application

Shown here are a few of the many types of Denver Agitators available to provide efficient, economical agitation in the mineral and chemical processing industries.

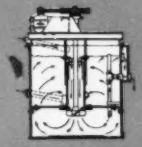
Turbine-Type (reducer drive)

Turbine-Type (spindle bearing drive)



Straight Blade Stirrer

Vertical Turbine



Super Agitator and Conditioner

Air-Lift Agitator

Kermac Nuclear Fuels Corporation Leaches -28 Mesh Sandstone Ore at 55% Solids in 28 Denver Turbine Type Agitators

Kermac Nuclear Fuels Corporation operates a 3300 ton rated capacity uranium mill in the Ambrosia Lake District north of Grants, New Mexico. The —28 mesh abrasive sandstone ore at 55% solids is acid leached using Denver Turbine Type Agitators. The 28 Denver Agitators used by Kermac Nuclear are arranged in two sections of 14 agitators each. The rubber-lined agitator tanks are 13′ diameter x 14′ high and use 48″ Denver Turbine Type Propellers, which are also rubber-covered and have an average service life of 18 months. The first two agitators in each circuit consume 15 HP each and the remaining units, 11 HP each.

The Agitator units are heavy-duty and can be easily started up under load after shutdown without auxiliary equipment. The mill design provides step-down elevations to provide gravity flow, and the tanks are arranged so that any tank in the section can be by-passed if necessary.

This large uranium producer has found Denver Agitators perform to their complete satisfaction on this severe service. This problem of agitating coarse abrasive slurries is another example of Denver experience in handling all types of agitator problems. Equipment is specially-designed to provide proper agitation and is backed by a qualified, experienced field service organization.

Write giving details of your processing requirements for detailed recommendation.

"The firm that makes its friends happier, healthier and wealthier"

DENVER

Steel-Head Mills

"Sub-A" Flotation

Agitators

Diaphragm Pumps

Automatic Samplers

SRL Pumps

Complete Mineral Processing Equipment

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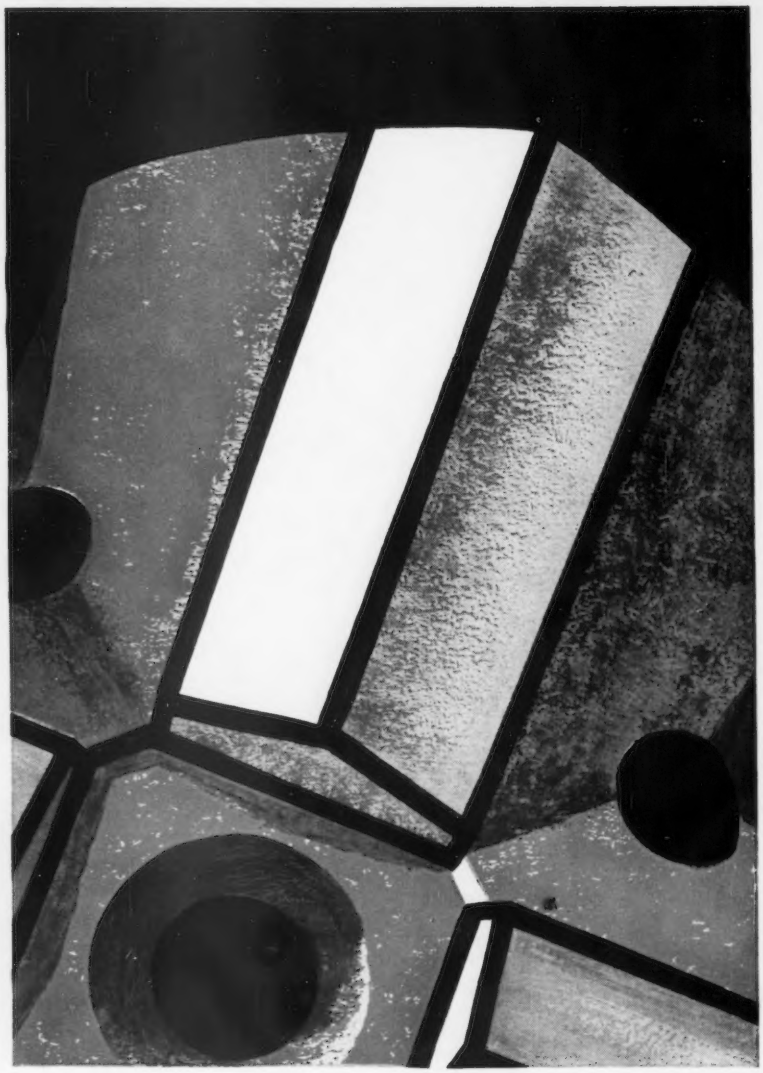
MORE HOLE PER-BIT



TO get lower cost per foot of hole drilled switch to the Timken® carbide insert bit—now improved to cut your drilling costs even more. One big improvement comes from our brazing process. It bonds the carbide inserts firmly to the bit body for greater shock-resistance. Inserts and bits last longer.

Another advance comes from improvements in our heat treating process. Experience helps us produce bit bodies of more uniform hardness and structure. Result is greater strength, practically eliminating ring-off and breakage.

More savings come from Timken bits' field-proven features. The 5 front hole design, pioneered by the Timken Company, directs air or water against the rock face, speeds chip removal. The deeper, wider wing clearance helps chips wash back faster.

With Timken bits you get on-the-job service, the kind you can't get anywhere else. Get full details about the complete line of Timken bits. Send for free brochure, "Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO". Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN®

removable rock bits

FOR OTHER TOUGH DRILLING JOBS

ALL-STEEL MULTI-USE

This improved Timken bit gives lowest cost per foot-of-hole in ordinary ground, when you can drill out full increments of steel.

TAPERED SOCKET BIT

Has same money-saving features as threaded bit. Secure union gives strength of one-piece steels.